# WELCOME

**NATIONAL EMERGENCY VEHICLE TECHNICIAN TRAINING ACADEMY 2014**

# E V T F-2

**PRESENTED BY ROB BURLEY**

## EVT F-2

Design & Performance Standards and Preventive Maintenance of Fire Apparatus

- References for this course and exam:
- IFSTA Pumping Apparatus DRIVER/OPERATOR
- Chapters 3, 4, 6,10,11,16 Glossary and Appendix "A"
- NFPA 1901, Standard for Automotive Fire Apparatus, ,
- Chapters 1-25 & Appendix

## Course Objectives

- Definitions
- General requirements of fire apparatus
- Test requirements for fire apparatus
- Principles of servicing and maintenance

- Handout - EVT Learning Objectives

## The NFPA Standards System

- They are minimum standards!
- Compliance with standards is voluntary
- Standards are developed by technical committees, not NFPA staff (see page 2)
- Committee members volunteer their time (No pay)
- Committee balance is mandatory

## NFPA 1901

Applies to **new** fire apparatus after 1/1/2009

- 25 Chapters covering performance and testing
- 1 appendix providing explanatory material
- 1 appendix for user to provide apparatus builder with necessary information

## NFPA 1901

- Chapters 1 - 14 Core chapters
- Chapters 15 - 24 Components
- Chapter 25 Referenced publications
- Tests included in appropriate chapter with component
- Size may vary but component requirements consistent

## Chapter 1- Administration

- Scope and Purpose
  - Applies to **new** fire apparatus designed for structural fire fighting or supporting associated fire department operations.
  - They are minimum standards! 1-2
- Responsibility
  - Of purchaser 1-5
  - Of contractor 1-6
- Definitions 1-7 ö

## Definitions

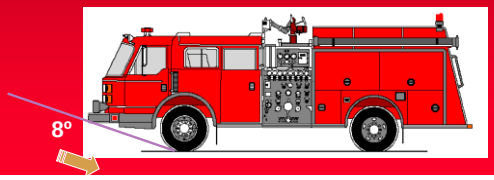
- **Acceptance tests:**
  - **Tests performed on behalf or by the purchaser at the time of delivery to determine compliance with the specifications for the fire apparatus.**

## Definitions

- Adjust: To maintain or regulate, within prescribed limits, by setting the operating characteristics to specified parameters. NFPA 1915
- Alignment: To adjust components to bring about optimum or desired performance. NFPA 1915

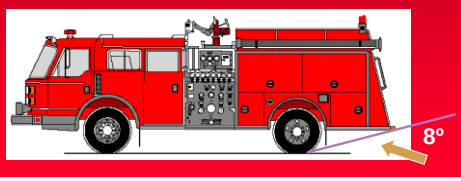
## Definitions

- **Angle of Approach:**
  - The smallest angle made between the road surface and a line drawn from the *front* point of ground contact of the front tire to *any projection* of the apparatus in front of the front axle. Minimum of 8 degrees.




## Definitions

- **Angle of Departure:**
  - The smallest angle made between the road surface and a line drawn from the *rear* point of ground contact of the rear tire to *any projection* of the apparatus behind the rear axle. Minimum of 8 degrees.




## Definitions

**Anti Electrocution Platform**

A platform on which the aerial operator stands to prevent electrical shock in case the aerial device contacts power lines.

## Definitions

- Atmospheric Pressure:

Pressure exerted by the atmosphere at the surface of the earth due to the weight of air. Atmospheric pressure at sea level is about 14.7 psi. Atmospheric pressure increases as elevation is decreased below sea level and decreases as elevation increases above sea level.

## Definitions

- Authority Having Jurisdiction (AHJ): *

  The organization, office, or individual responsible for approving equipment, an installation, or procedure.

- Authorized Person:

  A person approved or assigned to perform specific types of duties or to be at a specific location at the job site.

- Approved: *

  Acceptable to the authority having jurisdiction

## Definitions

- Automatic Electrical Load Management System

  A device that continuously monitors the electrical system voltage and sheds predetermined loads in a selected order to prevent over discharging of the apparatus' batteries. Shedding of the loads occurs without human intervention and is capable of being manually overridden.

## Definitions

- Auxiliary Cooler: 1901
  - There is no standard arrangement. Most use a marine-type of heat exchanger. May be built into the radiator or mounted separate.
  - Radiator coolant passes through copper tubing surrounded by water supplied by the pump.
  - The circulation of the pump water is controlled by a shutoff valve located on the pump panel.
  - There is no contamination of the cooling system and can be used at anytime to keep the engine temperature down.
- NOT to be confused with a radiator fill valve. Emergency use *only!* Dilutes coolant

NFPA

- Auxiliary coolers

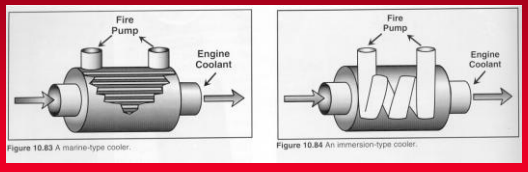



Figure 10.83 A marine-type cooler.

Figure 10.84 An immersion-type cooler.

NFPA

## Definitions

- Auxiliary Systems:
  - Secondary or reserve systems
  - I.e. Auxiliary braking system - in addition to the service brake, such as an engine retarder, transmission retarder, drive-line retarder, or exhaust retarder.
  - Could also refer to an electrical motor backup for a hydraulic pump should the main motor or PTO fail.

NFPA

## Definitions

Bleeder Valve:

Valve on a gated intake that allows air from an incoming supply line to be bled off before allowing the water into the pump.

## Definitions

Bonding

The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed

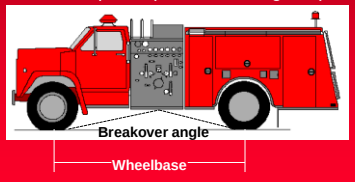
## Definitions

Bourdon Tube:

Part of a pressure gauge that has a curved, flat tube that changes its curvature as pressure changes. This movement is then transferred mechanically to a pointer on the dial.

## Definitions

- Break Over Angle: (glossary IFSTA)
  - The angle formed by level ground and a line from the point where the rear tires touch the ground to the bottom of the frame at the wheelbase midpoint, (at least 10 degrees).




## Definitions

- Calibrate: To correlate the readings of an instrument or system of measurement with a standard.
  - NFPA 1915

## Definitions

- Cavitation:
  - A condition in which vacuum pockets form in a pump and cause vibrations, loss of efficiency, and possible damage.
  - In theory, water is being discharged from the pump faster than it is coming in. Sometimes expressed as the pump running away from the water.
  - Indications: loud popping or sputtering sound (gravel going through the pump) with water flow and pressure gauge fluctuation. No increase on pressure gauge when rpm's are increased.
  - Causes: inadequate piping from the water tank, poor hydrant, and at draft from insufficient water flow into the pump (intake hose too small).

## Definitions

- Certification Test:
  - Pumper certification tests are conducted by a third party independent testing organization such as, Underwriters Laboratories (UL). A technician conducts the tests either at the manufacturer's plant or at the fire department after delivery.
  - Certification test must be required in the apparatus bid specifications, either by referencing NFPA 1901 or by specific wording. (p 380 & 381 IFSTA)

## Definitions

- Collector Rings: A means of transmitting electrical power to the aerial device turntable from the main power supply; usually, concentric rings made of brass that are contacted by brushes to make the transfer to the specific electrical function. NFPA 1915
- Component: A constituent part of a mechanical or electrical device. NFPA 1915

## Definitions

- Compound Gauge: *
  - A gauge that indicates pressure both above and below atmospheric pressure.
  - Term used to describe the gauge that measures the intake pressure on a fire pump.
  - Shall read from 30 in. Hg vacuum to at least a gauge pressure of 300 psi.

## Definitions

- Class “A” Foam
  - Foam intended for use on Class A fires. Class A foams are essentially wetting agents that reduce the surface tension of water and allow it to soak into combustible materials easier than plain water.
  - Extremely useful on wildland fires.

## Definitions

- Contractor: *
  - The person or company responsible for fulfilling an agreed upon contract. The contractor might not necessarily manufacture the vehicle or any portion of the vehicle but is responsible for the completion, delivery, and acceptance of the entire unit.

## Definitions

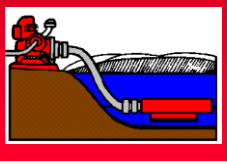
- Defect: A discontinuity in a part or a failure to function that interferes with the service or reliability for which the part was intended. NFPA 1915
- Defective: Having a defect, or faulty.
- Deformation: Abnormal wear, defects, cracks or fractures, warpage, and deviations from the original condition that would affect safe and correct operation. NFPA 1915

## Definitions

- Documentation: The process of gathering, classifying, and storing information. NFPA 1915

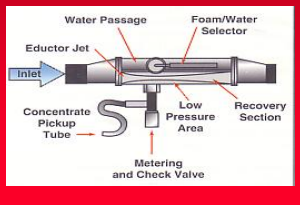
## Definitions

- Drafting Operation:
  - The process of drawing water from a static source into a pump that is above the level of the water supply.
  - Atmospheric pressure forces the water into the pump where a partial vacuum had been created.



## Definitions

- Eductor: A device placed in a hose line that incorporates a venturi and proportions foam concentrate into the water stream



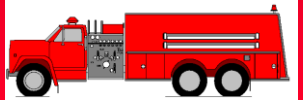
## Definitions

- **Failure:** A cessation of proper functioning of performance. NFPA 1915
- **Fire Apparatus:** A vehicle used for fire suppression or support by a fire department, fire brigade, or other agency responsible for fire protection. NFPA 1915
- **Combination Fire Apparatus:** A vehicle consisting of a pulling tractor and trailer.
- **Single Fire Apparatus:** A vehicle on a single chassis frame. NFPA 1915

## Definitions

- Fire Apparatus:

  A vehicle of 10,000 lb or greater gross vehicle weight rating (GVWR) used for fire suppression or support by a fire department, fire brigade, or other agency responsible for fire protection.



## Definitions

- Fire Pump:

  A water pump mounted on an apparatus with a rated capacity of 250 gpm or greater at 150 psi net pump pressure, and used for fire fighting.

## Definitions

- Frame: The basic structural system that transfers the weight of the fire apparatus to the suspension system. NFPA 1915

## Definitions

- Gauges:

  A round analog pressure-indicating device that uses mechanical means to measure pressure. Pumper must be supplied with two - a compound vacuum gauge (0-30 inches of vacuum and 0-300 psi pressure and a pressure gauge 0-300 psi. May have a discharge pressure gauge for each discharge.

- Other types of gauges:

  speedometer, tachometer, oil pressure, ammeter, voltmeter, air pressure, water temperature, and fuel gauge.

## Definitions

- Grade: *
  - A measurement of the angle used in road design and expressed as a percentage of elevation change over distance.
  - A 45-degree slope is equal to a 100 percent grade.

## Definitions

- Gross Axle Weight Rating (GAWR) *
  - The chassis manufacturer's specified maximum, load-carrying capacity of an axle system, as measured at the tire ground interfaces.
- Gross Combination Weight Rating (GCWR) *
  - The chassis manufacture's specified maximum, load carrying capacity of a combination vehicle. Pulling tractor and trailer.
- Gross Vehicle Weight Rating *
  - The chassis manufacture's specified maximum load-carrying capacity of a vehicle having two axle systems (a multiaxle axle installation is one system.

## Definitions

- Ground clearance: The clearance under a vehicle at all locations except the axles and driveshaft connections to the axle, minimum 8"

## Definitions

- Industrial Supply Pump: A water pump mounted on a mobile foam fire apparatus with a rated capacity of 3000gpm or greater at 100psi npp.

## Definitions

- Initial Attack Fire Apparatus:
  - Fire apparatus with:
  - 1) a permanently mounted fire pump at least 250 gpm,
  - 2) a water tank, and
  - 3) hose body that meets or exceeds the requirements of this standard.
  - The primary purpose of this type apparatus is to initiate a fire suppression attack on structural, vehicular, or vegetation fires, and to support associated fire department operations.
  - Often referred to as minipumper or midipumper.

## Definitions

- Inspect: To determine the condition or operation of a component(s) by comparing its physical, mechanical, and/or electrical characteristics with established standards, recommendations, and requirements through examination by sight, sound, or feel. NFPA 1915

## Definitions

- Intake Hose (hard suction hose):
  A flexible, rubberized length of hose with a steel core that connects a pump to a source of water. Most commonly used for drafting.
- Soft Sleeve Hose (soft suction):
  A large diameter, collapsible piece of hose used to connect a fire pump to a pressurized water supply system.

## Definitions

- Intake relief valve: A relief valve piped to the intake manifold of a pump and designed to automatically relieve excess pressure from the incoming flow of water by discharging water to the environment

## Definitions

- Interlock: A device or arrangement by means of which the function of one part is controlled by the functioning of another. NFPA 1915
- Ironing: Damage in the form of wear or indentations caused to the bottom of the aerial device base rail material by misalignment of the rollers. NFPA 1915

## Definitions

- Line Voltage Circuit, Equipment, or System:
  An “ac” or “dc” electrical circuit, equipment, or system where the voltage to ground or from line to line is 30 volts rms. (ac) or 42.4 volts peak (dc) or greater, but does not exceed 275 volts rms. (ac) or peak (dc).
- Low Voltage Circuit, Equipment, or System:
  An” electrical circuit, equipment, or system where the voltage does not exceed 30 volts rms. (ac) or 42.4 volts peak (dc), usually 12 volts dc in fire apparatus.

## Definitions

- Leakage: The escape of a fluid from its intended containment, generally at a connection. The three classes of leakage are defined. NFPA 1915
- Class 1: Seepage of fluid, as indicated by wetness or discoloration, not great enough to form drops. NFPA 1915

## Definitions

- Class 2: Leakage of fluid great enough to form drops, but not enough to cause drops to fall from the item being inspected. NFPA 1915
- Class 3: Leakage of fluid great enough to cause drops to fall from the item being inspected. NFPA 1915

## Definitions

- Lugging:
  - A condition that exist when the engine is operating at full throttle but below rated speed. This is know as Over throttling. The throttle is fully depressed with no response to the accelerator.
  - Lugging can be eliminated by using a lower gear and proper shifting techniques.
  - Over throttling occurs when more fuel is being injected than can be burned. This causes excess carbon in the exhaust, oil dilution, and additional fuel consumption.

## Definitions

- Maintenance: The act of servicing a fire apparatus or a component within the time frame prescribed by the authority having jurisdiction,based on the manufacturer's recommendations, local experience, and operating conditions in order to keep the vehicle and its components in proper operating condition. NFPA 1915

## Definitions

- Manufacturer's Recommendation (Specification): Any requirement or suggestion a fire apparatus builder or component producer makes in regard to care and maintenance of its product(s). NFPA 1915

## Definitions

- Manufacturer's Test:
  Fire pump or aerial device tests performed by the manufacturer prior to delivery of the fire apparatus.
- The test required by 1901-14-13.2.3.1 include:
  *Three-Hour Pumping Test* - insures that pump components are installed properly. Pump must be operated continuously at draft for 2 hours minimum before stopping.
  100% of rated capacity @ 150 psi - 2 hour
  70% of rated capacity @ 200 psi - 30 min.
  50% of rated capacity @ 250 psi - 30 min.

## Definitions

*Hydrostatic Test* - 1901 - 14-5.2: determines if pump and piping can withstand pressures normally encountered.
The test is conducted at 500 psig with the tank fill line valve, the by-pass line valve and the tank to pump valve closed. Discharge valves open with outlets capped. All intake valves closed, and non-valved intakes capped. Maintain pressure for 10 minutes. Pump manufacturer supplies certificate of completion.
*Other tests*: As prescribed by purchaser - tank-to-pump flow test, acceleration tests, braking tests, noise level readings, or other features per purchaser.

## Definitions

- Modification: An alteration or adjustment to any component that is a deviation from the original specification or design of the fire apparatus. NFPA 1915

## Definitions

- Net Pump Pressure: *
- Net Pump Discharge Pressure:
  - The actual amount of pressure being produced by the pump.
  - When pumping at draft, the sum of the discharge pressure and the suction lift converted to psi or kPa.
  - Ex. Discharge gauge reads 145 psig and the intake gauge reads 10 in. of mercury vacuum. The net pump pressure will be 150 psi.
  - 145 psi + 5 psi (1 in. Hg = 0.5 psi).

(cont.)

## Definitions

- Net Pump Pressure cont.:
  - When pumping from a hydrant or other source of water under positive pressure, the difference between the discharge pressure and the intake pressure
  - Ex. - The discharge gauge reads 150 psi and the intake gauge reads 20 psig, the net pump pressure equals 130 psi.

## Definitions

- No Load Governed Speed: 1901 - A-10-2.1.1
  - The maximum rpm allowed by engine governor when throttle is placed in wide-open position when there is no driving or pumping load on the engine.
  - Maximum governed speed is established by the engine manufacturer as a safe limit of engine speed.
  - Most manufacturers allow a plus tolerance of 2% for maximum governed speed.

## Definitions

- Operator Alert Device: Any device, whether visual, audible, or both, installed in the driving compartment or at an operation's panel, to alert the operator to either a pending failure, an occurring failure, or a situation that requires his or her immediate attention. NFPA 1915

## Definitions

- Optical Source: Any single, independently mounted, light-emitting component in a lighting system. NFPA 1915
- Overhaul: To inspect, identify deficiencies,and make necessary repairs to return component to operational condition. NFPA 1915

## Definitions

Override

A system or device used to neutralize a given action or motion

(aerial device)

The take over of all aerial device movement control function by an operator at a second control station

## Definitions

- Power Train: The Part of a fire apparatus that transmit power from the engine to the wheels, including the transmission, split shaft power takeoff, midship pump transmission, drive shaft(s), clutch, differential(s), and axles. NFPA 1915

## Definitions

- Powered Equipment Rack: A power-operated device that is intended to provide storage of hard suction hoses, ground ladders, or other equipment, generally in a location above apparatus compartments. NFPA 1915
- Proper: As recommended by the manufacturer. NFPA 1915

## Definitions

- Pressure Control Device: (14-10.7.1)

  A system that when set according to the manufacturer's instructions will automatically control the discharge pressure to a maximum of 30 psi rise above set pressure when all discharge valves are closed no more rapidly than in 3 seconds, and no more slowly than in 10 seconds during the following conditions:

•Range of pressures from 90psi to 250psi NPP

•Over a range of flows from 150 gpm to the rated capacity of the pump

## Definitions 14-10.7.2

The system could consist of a discharge relief valve, a pressure regulator that controls the speed of the pump, an intake relief valve, or any combination of these devices.

A yellow indicator light located on the pump operators panel must illuminate when the pressure control system is in control of the pressure in the pump.

If the pump is equipped with a governor system that controls engine speed, an indicator shall show when the system is turned on and whether it is controlling the engine speed or pump pressure.

If the system discharges water to the atmosphere, the discharge shall be in a manner that will not expose personnel to high-pressure water streams.

## Definitions

- Pressure Governor (IFSTA p 230)

  Pressure can also be regulated on centrifugal pumps by a mechanical or electronic governor that is pressure activated to adjust the engine throttle.

  The main feature of a pressure governor is that it regulates the power output of the engine to match pump discharge requirements.

## Definitions

- Pre-service tests

  Test performed on fire pumps or aerial devices before they are placed into service. These tests are broken down into manufacturer's test, certification tests, and acceptance tests.

## Definitions

- Preventive Maintenance: The act or work of keeping something in proper condition by performing necessary preventive actions, in a routine manner, to prevent failure or breakdown. NFPA 1915

## Definitions

- Pump and Roll

  Ability of an apparatus to pump water while the vehicle is in motion.

  14-2.2 Where the apparatus is designed for pump and roll operations, the minimum performance shall be 20 gpm at 80 psi at an apparatus ground speed on level ground of 2 mph.

## Definitions

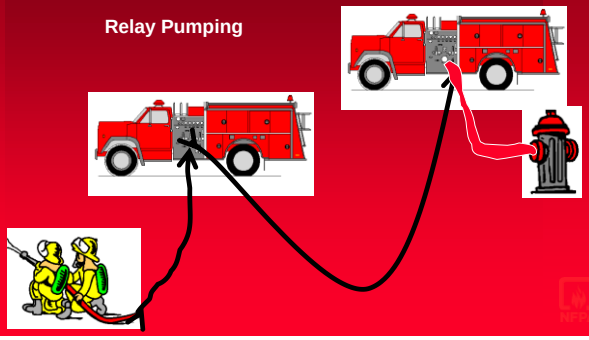
- Qualified Person: A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, work or project. NFPA 1915

## Definitions

- Relay Pumping:
  - The process of using two or more pumpers to move water through hoselines over a long distance by operating the pumpers in series.
  - A relay operation is based on the amount of water needed and the distance from the fire scene to the water source.
  - Two main types of pressure loss that a relay operation must overcome: elevation pressure and friction loss.
  - Remember - maximum capacity @ 150 psi net pump discharge.

## Definitions

**Relay Pumping**



## Definitions

- Repair: To restore to sound condition after failure or damage. NFPA 1915
- Replace: To remove an unserviceable item and install a serviceable counterpart in its place. NFPA 1915

## Definitions

- Responsibility of Purchaser (1-5)

  It shall be the responsibility of the purchaser to specify the details of the apparatus; its required performance, including where operations at elevations above 2000 ft or on grades greater than 6 percent are required; the maximum number of fire fighters to ride within the apparatus; specific added continuous electrical loads that exceed the minimum requirements of this standard; and any hose, ground ladders, or equipment to be carried by the apparatus that exceed the minimum requirements of this standard.

## Definitions

- Severe Service: Those conditions that apply to the rigorous, harsh, and unique applications of fire apparatus, including but not limited to local operating and driving conditions, frequency of use, and manufacturer's severe service(duty) parameters. NFPA 1915
- Shall: Indicates a mandatory requirement. NFPA 1915

## Definitions

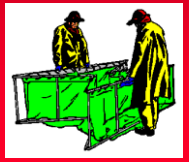
- Should: Indicates a recommendation or that which is advised but not required. NFPA 1915
- Steering Axle: Any axle designed such that the wheels have the ability to turn the vehicle. NFPA 1915

## Definitions

- Split Shaft PTO
  - A power take-off (PTO) drive system that is inserted between the chassis transmission and the chassis drive axle and that has the shift mechanism necessary to direct the chassis engine power either to the drive axle or to a fire pump or other accessory.

## Definitions

- Static Water Supply:
  - A non-pressurized source of water that pumpers may draft from for fire fighting or other operations.
  - Lakes, streams, ponds, swimming pools, dump tanks, cisterns, and other reservoirs.



## Definitions

- **Test: To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.** NFPA 1915
- **Operational Test: A test to determine the operational readiness of a component on a fire apparatus by observing the actual operation of the component.** NFPA 1915

## Definitions

- Triple Combination Pumper

  Fire department pumper that carries:

  – a fire pump,
  – hose,
  – and a water tank

## Definitions

- Vehicle Carrying Capacity: 1901- A-10-1

  All vehicles are designed for a maximum GVWR or maximum total weight, which should not be exceeded by the apparatus manufacturer or the purchaser after the vehicle has been placed into service.

  Factors making up the rated GVWR: design of the springs or suspension, rated axle capacity, rated wheel and tire loading, and weight distribution between the front and rear wheels. (cont.)

## Definitions

One of the most critical factors is the size of the water tank. Water weighs approximately 8 1/3 lb/gal. To estimate the weight of the tank and the water, use 10 lb/gal, thus making a 500 gal tank and its water weigh about 2 1/2 tons.

If the finished apparatus is not to be overloaded, the purchaser should provide the contractor with the weight of equipment to be carried if it is in excess of the allowance shown in Table 10-1 (p 22 - NFPA 1901)

## NFPA 1901

Automotive Fire Apparatus Definitions

Questions ?

## NFPA 1901

**General Requirements**

## Chapter 4-1 General Requirements

- Steering chapter for all apparatus
- All apparatus shall meet requirements of:
  - –Chapter 1, Administration
  - –Chapter 4, General Requirements
  - –Chapter 12, Chassis and Vehicle Components
  - –Chapter 13, Low-Voltage Electrical Systems and Warning Devices
  - –Chapter 14, Driving and Crew Areas
  - –Chapter 15, Body Compartments, and Equipment Mounting

## Chapter 4-2 Requirements by Apparatus Type

- 4-2.1 Requirements by Apparatus Type (Traditional)

  In addition to Section 4-1 the following shall apply:

  (1) Pumper apparatus shall comply with Chap. 5

  (2) Initial attack fire apparatus shall comply with Chap. 6

  (3) Mobile water supply fire apparatus shall comply with Chap. 7

  (4) Aerial apparatus shall comply with Chap. 8

  (5) Quint fire apparatus shall comply with Chap. 9

  (6) Special service apparatus shall comply with Chap. 10

  (7) Mobile foam apparatus shall comply with Chap. 11
- 4-2.2 See Table 4-2.2 (page 12 ) required chapters for apparatus in 4-2.1

## Chapter 4-2 Requirements by Apparatus Type

- 4-2.3 Non-traditional apparatus other than those in 4-2.1

  Combination of requirements for components to be used as defined in Section 4-3 with the requirements listed in Section 4-1.

## Chapter 4.5 Fire Apparatus Components

- All components shall be installed in accordance with the applicable manufacturer's installation instructions.
  - 4.5.1 Fire Pump - Chap. 16
  - 4.5.2 Auxiliary Pump - Chap. 17
  - 4.5.3 Industrial Supply Pump - Chap. 18
  - 4.5.5 Water Tank - Chap. 19
  - 4.5.5 Aerial Device - Chap. 20
  - 4.5.6 Foam Proportioning System - Chap. 21
  - 4.5.7 Compressed Air Foam System (CAFS) - Chap. 22

## Chapter 4.5 Fire Apparatus Components

- All components shall be installed in accordance with the applicable manufacturer's installation instructions.
  - 4.5.8 Line Voltage Electrical System (120/240) - Chap. 23
  - 4.5.9 Command and Communications - Chap. 24
  - 4.5.10 Air System - Chap. 25
  - 4.5.11 Winch System - Chap. 26

## Chapter 2-4 Governmental Requirements

- The apparatus shall comply with all applicable federal and state motor vehicle laws and regulations.

## Chapter 4.9 Personnel Protection

- 4.9.1
  - Guards and shields to prevent injury from hot, moving, or rotating parts during non-maintenance operations.
  - Electrical insulation to prevent shock.
- workmanship - no sharp corners or sharp edges. 4.9.3
  - Vehicle
- 4.9.4
  - Safety warning tags and labels.
    - Permanently attached and stand extremes of weather and temperature.

## 4.10 Controls and Instructions *

- 4.10.1 Illumination shall be provided for controls, switches, instruction plates, labels, gauges, and instruments necessary for the operation of the apparatus and the equipment provided on it.
- 4.10.1.1 If external illumination is provided, it shall be a minimum of 5 fc (50 lx) on the face of the device.
- 4.10.1.2 If internal illumination is provided, it shall be a minimum of 4 footlamberts (14 cd/m2).

## 4.10 Controls and Instructions*

- 4.10.2* All required signs, instruction plates, and labels shall be permanent in nature and securely attached and shall meet the requirements of 4.9.4 and UL 969, *Standard for Marking and Labeling Systems*.
- 4.10.2.1 The signs, instruction plates, and labels shall have resistance to damage from temperatures between –30°F and 176°F (–35°C and 80°C) and exposure to oil, fuel, water, hydraulic fluids, or other fluids used on the apparatus.
- 4.10.2.2 The exterior mounted labels relating to safety or critical operational instructions shall be reflective or illuminated

## 4.11 Vehicle Data Recorder*

- **4.11.1** All apparatus shall be equipped with an on-board vehicle data recorder (VDR).
- **4.11.2** The VDR shall be capable of recording the data shown in Table 4.11.2 in that order at least once per second.

## Table 4.11.2 VDR Data*

| Data | Unit of Measure |
|---|---|
| Vehicle speed: | mph |
| Acceleration: (from speedometer) | mph/sec |
| Deceleration: (from speedometer) | mph/sec |
| Engine speed: | rpm |
| Engine throttle position: | % of full throttle |
| Anti-lock braking system event: | On/off |
| Seat occupied status: | Occupied: Yes/No by position |
| Seat belt status: | Buckled: Yes/No by position |
| Master optical warning device switch: | On/off |
| Time: | 24-hour clock |
| Date: | Year/month/day |

## 4.11 Vehicle Data Recorder*

- **4.11.3** Data shall be stored at the sampling rate in a 48-hour loop.
- **4.11.4** Memory shall be sufficient to record 100 engine hours' worth of minute-by-minute summary showing the data in Table 4.11.4.
- **4.11.5** When the memory capacity is reached, the system shall erase the oldest data first.
- **4.11.6** All data stored in the VDR shall be uploadable by the user to a computer and importable into a data management software package.
- **4.11.7** Data shall be password protected with access controlled by the purchaser

## 4.11 Vehicle Data Recorder*

- **4.11.5** When the memory capacity is reached, the system shall erase the oldest data first.
- **4.11.6** All data stored in the VDR shall be uploadable by the user to a computer and importable into a data management software package.
- **4.11.7** Data shall be password protected with access controlled by the purchaser

## 4.11 Vehicle Data Recorder*

- **4.11.8** Software shall be delivered with the apparatus that will run on both Windows® and Apple® operating systems and produce the following formatted reports from the uploaded data:
- (1) Raw second-by-second data over a specified data/time range
- (2) Daily log for the time the engine is running for a given date (minute-by-minute output of all values)
- (3) Weekly summary (maximum values each hour for each day of the week)
- (4)Monthly summary (maximum values each day for each day of the month)

## **Chapter 4.12** Component Protection

- Hydraulic lines, air system tubing, control cables, and electrical lines shall be clipped to the frame or body structure of the apparatus and shall be furnished with protective looms, grommets, or other devices at each point where they pass through body panels or structural members or wherever they lay against a sharp metal edge.

## 4.13.1 Rollover Stability *

- **4.13.1.1** The apparatus shall meet the criteria defined in either of the following:
- **(1)*** The apparatus shall remain stable to 26.5 degrees in both directions when tested on a tilt table in accordance with SAE J2180, *A Tilt Table Procedure for Measuring the Static Rollover Threshold for Heavy Trucks*.
- (2) The calculated or measured center of gravity (CG) shall be no higher than 80 percent of the rear axle track width

## Chapter 4.13 Vehicle Stability

- Height of the fully loaded vehicles center of gravity not to exceed manufacturer's maximum limit.
- Front axle loads shall not be less than the minimum load specified by the mfg.
- Side to side difference at axle ends not to exceed 7%

## Chapter 4.13 Apparatus Performance

Shall meet the requirements of the standard:

- 4.13.1
  At 2,000 feet of elevation
- 4.13.2
  While stationary on any grade of up to and including 6% in any direction
- 4.13.3*
  In ambient temperature conditions between 32ºF and 110ºF

## Chapter 4.15 Roadability

- When fully equipped and loaded per 10-1, shall perform the following on dry, paved roads in good condition:

(1) 0-35 mph in 25 seconds on level road

(2)* Min. 50 mph top speed on level road

(3)* Maintain 20 mph on any grade up to and including 6%

## Chapter 4.15 Roadability *

- **4.15.2*** The maximum top speed of fire apparatus with a GVWR over 26,000 lb (11,800 kg) shall not exceed either 68 mph (105 km/hr) or the manufacturer's maximum fire service speed rating for the tires installed on the apparatus, whichever is lower.

## Chapter 4.15 Roadability *

- **4.15.3** If the combined water tank and foam agent tank capacities on the fire apparatus exceed 1250 gal (4732 L), or the GVWR of the vehicle is over 50,000 lb (22,680 kg), the maximum top speed of the apparatus shall not exceed either 60 mph (85 km/hr) or the manufacturer's maximum fire service speed rating for the tires installed on the apparatus, whichever is lower

## **Chapter 4.16** Serviceability

- All manufacturer recommended routine maintenance checks of lubricant and fluid levels can be performed without lifting the cab of a tilt-cab apparatus or the need for hand tools.

nt.

## **Chapter 4** Serviceability

Special tools required for routine service to be provided with the apparatus.

Apparatus components that interfere with repair or removal of other major components shall be attached with fasteners, such as cap screws and nuts, so that the components can be removed and installed with ordinary hand tools. These components shall not be welded or otherwise permanently secured into place

## **Chapter 4** Serviceability

Apparatus components that interfere with repair or removal of other major components shall be attached with fasteners, such as cap screws and nuts, so that the components can be removed and installed with ordinary hand tools. These components shall not be welded or otherwise permanently secured into place

## Chapter 4 Serviceability

- Contractor shall supply at least two copies of a complete operation and service manual for the apparatus as delivered and accepted which will include the following:(see page 14)
  - (1) Descriptions, specifications, and ratings
  - (2) Wiring diagrams
  - (3) Lubrication charts
  - (4) Operating instructions
  - (5) Precautions
  - (6) Instructions for recommended maintenance
  - (7) Parts replacement information

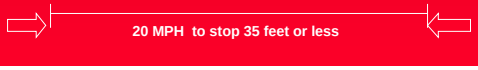
## Chapter 4.17 Road Tests

- Equipped and loaded per 10-1
- Two runs in opposite directions
- True speed of 35 mph - 25 seconds from a standing start
- Minimum top speed of 50 mph

## Chapter 4.17 Road Test

Auxiliary braking system to function as intended by manufacturer

- Service brake - fully laden vehicle to a complete stop from 20 mph in 35 feet or less Hydraulic brakes from 30 mph stop in 88 ft



## 4.18 Tests on Delivery *

- **4.18.1*** If acceptance tests are required at the point of delivery, the purchaser shall specify the details of the tests to be performed, and they shall not be performed in a manner that requires the apparatus or a component to operate outside its designed operating range.
- **4.18.2** Aerial device stability tests shall not be run other than at the manufacturer's facility.

## 4.19 Documentation *

- Any documentation delivered with the apparatus shall be permitted to be in printed format, electronic format, audiovisual format, or a combination thereof.

## Chapter 4.20 Data required from the Contractor

- Contractor shall supply at delivery (min. one copy):

Manufacturer's record of apparatus construction details including:

(1) Owners name and address
(2) Apparatus manufacturer, model, and serial number
(3) Chassis make, model, and serial number
(4) GAWR of front / rear axles
(5) Front / rear tires size and rated capacity in pounds
(6) Chassis weight distribution in lbs. w/ water & equip.
(7) Engine make, model, serial number, rated hp & speed
(8) Type of fuel and tank capacity

(see list pg. 14)

## 4.21 Statement of Exceptions *

- The entity responsible for final assembly of the apparatus shall deliver with the fire apparatus either a certification that the apparatus fully complies with all requirements of this standard or, alternatively, a Statement of Exceptions specifically describing each aspect of the completed apparatus that is not fully compliant with the requirements of this standard at the time of delivery

## 4.21 Statement of Exceptions *

- **4.21.1** The Statement of Exceptions shall contain, for each noncompliant aspect of the apparatus or missing required item, the following information
- (1) A separate specification of the section of the applicable standard for which compliance is lacking
- (2) A description of the particular aspect of the apparatus that is not in compliance therewith or required equipment that is missing

## 4.21 Statement of Exceptions *

- (4) Identification of the entity that will be responsible for making the necessary post delivery changes or modifications or for supplying and installing any missing required equipment to the apparatus to achieve full compliance with this standard

## 4.21 Statement of Exceptions *

♦**4.21.2** Prior to, or at the time of, delivery of the apparatus, the Statement of Exceptions shall be signed by an authorized agent of the entity responsible for final assembly of the apparatus and by an authorized agent of the purchasing entity, indicating mutual understanding and agreement between the parties regarding the substance thereof.

## 4.21 Statement of Exceptions *

♦**4.21.3** An apparatus that is delivered subject to a Statement of Exceptions other than a certification of full compliance shall not be placed in emergency service until the apparatus has been modified as necessary to accomplish full compliance with this standard.

## Chapter 5 - Pumper Fire Apparatus

- Fire pump

  Pump size - 750 gpm minimum (Chap. 16)
- Aerial Device

  If equipped - meet requirements of Chap.19

  Permanent waterway - pump to supply flow requirements with maximum of 20 psi at intake

  Pump operator not to be in contact with ground

## Chapter 5 Pumper Fire Apparatus

- Water Tank size min. 300 gal for pumpers
- 40 cub. ft. compartment space
- (1) hose storage 30 cu ft
- 3 ground ladders – 1 ext, 1 straight,1 attic
  ( no specified length)
- suction hose - 15' soft or 20' harg
- Minor equipment
  Fire hose & nozzles (800 ft. of 2 1/2 in.)

## Chapter 5 Pumper Fire Apparatus *

- **5.8.3* Miscellaneous Equipment.** The following additional equipment shall be carried on the apparatus:
- (1) One 6 lb (2.7 kg) flathead axe mounted in a bracket fastened to the apparatus
- (2) One 6 lb (2.7 kg) pickhead axe mounted in a bracket fastened to the apparatus
- (3) One 6 ft (2 m) pike pole or plaster hook mounted in a bracket fastened to the apparatus
- (4) One 8 ft (2.4 m) or longer pike pole mounted in a bracket fastened to the apparatus

## Chapter 5 Pumper Fire Apparatus *

- (5) Two portable hand lights mounted in brackets fastened to the apparatus
- (6) One approved dry chemical portable fire extinguisher with a minimum 80-B:C rating mounted in a bracket fastened to the apparatus
- (7) One 2 gal (9.5 L) or larger water extinguisher mounted in a bracket fastened to the apparatus

## Chapter 5 Pumper Fire Apparatus *

- (8) One self-contained breathing apparatus (SCBA) complying with NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, for each assigned seating position, but not fewer than four, mounted in brackets fastened to the apparatus or stored in containers supplied by the SCBA manufacturer

## Chapter 5 Pumper Fire Apparatus *

- (9) One spare SCBA cylinder for each SCBA carried, each mounted in a bracket fastened to the apparatus or stored in a specially designed storage space
- (10) One first aid kit

## Chapter 5 Pumper Fire Apparatus *

- (11) Four combination spanner wrenches mounted in brackets fastened to the apparatus
- (12) Two hydrant wrenches mounted in brackets fastened to the apparatus
- (13) One double female 2 in. (65 mm) adapter with National Hose (NH) threads, mounted in a bracket fastened to the apparatus

## Chapter 5 Pumper Fire Apparatus *

- (14) One double male 2 in. (65 mm) adapter with NH threads, mounted in a bracket fastened to the apparatus
- (15) One rubber mallet, suitable for use on suction hose connections, mounted in a bracket fastened to the apparatus
- (16) Two salvage covers each a minimum size of 12 ft 14 ft (3.7 m 4.3 m)

## Chapter 5 Pumper Fire Apparatus *

- (17)Two or more wheel chocks, mounted in readily accessible locations, that together will hold the apparatus, when loaded to its GVWR or GCWR, on a hard surface with a 20 percent grade with the transmission in neutral and the parking brake released

## Chapter 5 Pumper Fire Apparatus *

- 18) One traffic vest for each seating position, each vest to comply with ANSI/ISEA 207, *Standard for High-Visibility Public Safety Vests*, and have a five-point breakaway feature that includes two at the shoulders, two at the sides, and one at the front

## Chapter 5 Pumper Fire Apparatus *

- 19) Five fluorescent orange traffic cones not less than 28 in. (711 mm) in height, each equipped with a 6 in. (152 mm) retro-reflective white band no more than 4 in. (102 mm) from the top of the cone, and an additional 4 in. (102 mm) retro-reflective white band 2 in. (51 mm) below the 6 in. (152 mm) band

## Chapter 5 Pumper Fire Apparatus *

- (20) Five illuminated warning devices such as highway flares, unless the five fluorescent orange traffic cones have illuminating capabilities
- (21) One automatic external defibrillator (AED)

## Chapter 6- Initial Attack Fire Apparatus

- Fire pump
  Minimum 250 gpm
- Water tank
  Minimum 200 gal tank
- Equipment storage
  22 cub. ft. compartment space
- Ground Ladders
  1- 12-ft or longer ladder
- Miscellaneous equipment

## Chapter 7 - Mobile Water Supply Apparatus

- Pump
  - No pump required
- Water tank
  - Minimum 1000 gal tank
- Equipment storage
  - 20 cub. ft. compartment space
- Equipment
  - Minimum amount of miscellaneous equipment
- Portable tank no longer mandatory

## Chapter 8 - Aerial Fire Apparatus

- General
  - Applies to apparatus operating as aerial apparatus
  - Use Chapter 3 if operating as a pumper with an aerial device
- Aerial Device
  - Requirements in chapter 19
- Fire Pump (not required)
  - if equipped - meet Chap. 16
- Water tank (not required)
  - if equipped - meet Chap. 18

## Chapter 8 - Aerial Fire Apparatus

- Equipment storage
  - 40 cub. ft. compartment space
- Ground ladders
  - 115 ft. of ground ladders (must be new) supplied and installed by the contractor
  - 1- folding attic; 2- straight w/hooks; 2- extension
- Equipment
  - 6-8.1 list updated - (see pg. 23) 4 pike poles

## Chapter 9 Quint Fire Apparatus

- Fire Pump
  1000 gpm minimum
- Aerial Device
  Aerial ladder or platform with waterway - Chap. 19
- Water Tank
  Minimum 300 gal. - Chap 18
- Equipment Storage
  40 cu. ft.
- Ground Ladders
  Minimum of 85 ft.
  1- extension; 1-straight w/hooks; 1-attic
- Equipment

## Chapter 10 - Special Service Apparatus

- Pumps, tanks and most equipment are optional
- Equipment Storage
  120 cubic feet of compartment space
- Ground Ladders
  None required (if carried must meet NFPA 1931)
- Minor Equipment
  Minimum equipment required before placed in service
- Extensive list of suggested equipment in appendix (not required)
- Do not over load or under load vehicle - check GVWR - affects handling characteristics

## Chapter 11 - Mobile Foam Fire Apparatus

- Fire Pump
  Minimum capacity of 750 gpm
- Aerial Device
  If equipped - meet Chap. 19 & have a permanent waterway. Pump must be able to supply flow required.
- Foam Proportioning System
  Meet Chap. 21 requirements
- Foam Tank
  Concentration tank(s) with capacity of 500 gal.
  Meet Chap. 20
- Equipment Storage
  Minimum of 40 cu. ft.

## Chapter 11 - Mobile Foam Fire Apparatus

- Fire Hose and Nozzles
  - 800 ft. of 2 1/2”
  - 400 ft. of 1 1/2” or 1 3/4”
  - 4 - Foam or Spray nozzles 200 gpm (min.)
  - 2 - Foam or Spray nozzles 95 gpm (min.)
  - 1 - Pre-connected monitor rated at a minimum of 1000 gpm mounted on top of vehicle with a foam or spray nozzle rated at 1000 gpm.
- Misc. Equipment - see list pg. 21
- With an aerial device, 4 ladder belts

## Chapter 12 - Chassis and Vehicle Components

- Carrying Capacity
  - Weight allowance for equipment varies according to vehicle type and GVWR
  - See Table12-1 for equipment weight allowances
- Chassis Engine
  - Engine speed control and interlock required
  - Audible and visual warning for high engine temperature and low oil pressure
  - No auto shutdown, unless part of engine management system that cannot be disabled
- Cooling System
  - Maintain a temperature at or below manufacturer’s max. temp. rating under all conditions for which the apparatus is designed.

## Chapter 12 - Chassis and Vehicle Components

- Lubrication System
  - Permanent plate in driving compartment shall specify quantity and type of fluids (see list pg. 28)

## Chapter 12 - Chassis and Vehicle Components

- Fuel and Air System
  - Both diesel and gas engines
    - Air filter provided
    - Inlet restrictions within manufacturer's specifications
    - An air restriction indicator in cab visible to the driver
- Exhaust System
  - Discharge away from: apparatus body and equipment, operators position, **contact area of stabilizers and ground**. Exposed parts shielded.

## 12.2.4 Air Intake System *

- **12.2.4.1*** An air filter shall be provided in the engine's intake air system.
- **12.2.4.2** Air inlet restrictions shall not exceed the engine manufacturer's recommendations.
- **12.2.4.3*** The air inlet shall be equipped with a means of separating water and burning embers from the air intake system

## 12.2.6.7 Diesel Particulate Filter *

- . If the apparatus is driven by a diesel engine equipped with a diesel particulate filter (DPF), the requirements of 12.2.6.7.1 through 12.2.6.7.6 shall apply.
- **12.2.6.7.1** The regeneration process shall be activated by two methods:

## 12.2.6.7 Diesel Particulate Filter *

- **(1)*** Automatically by the engine system but only when the transmission is in gear and the speedometer indicates a speed above 5 mph (8 km/hr), whether the apparatus is in motion or is operating in stationary pump mode with an engine rpm sufficient to register 5 mph (8 km/hr) on the speedometer
- (2) Manually when initiated by activation of a switch located in the driver's area of the driving compartment

## 12.2.6.7 Diesel Particulate Filter *

- **12.2.6.7.2** Instructions for initiating the manual regeneration process shall be explained in the apparatus operator's manual.
- **12.2.6.7.3*** A switch shall be provided at the driver's area that will inhibit DPF regeneration until the switch is reset or the engine is shut down and restarted

## 12.2.6.7 Diesel Particulate Filter *

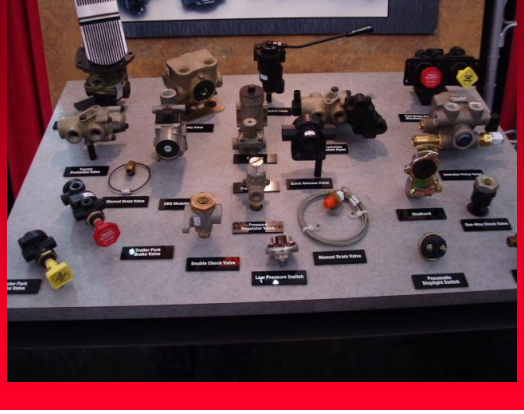
- **12.2.6.7.4** A DPF icon visible to the driver when seated in the driver's seat shall be illuminated to indicate that the DPF requires active regeneration.
- **12.2.6.7.5** A high exhaust system temperature (HEST) icon visible to the driver when seated in the driver's seat shall be illuminated to indicate that an active regeneration process has been initiated

## 12.2.6.7 Diesel Particulate Filter *

- **12.2.6.7.6*** Engine exhaust gas temperature shall not exceed 851°F (455°C) when measured at the exit of the exhaust pipe during normal DPF regeneration.

## Chapter 12 - 3 Vehicle Components

- Braking System
  - All wheel, anti-lock brakes required, if available from chassis manufacturer.
  - Service and parking brakes independent systems
  - Service brake application valve shall operate all service brakes on the vehicle or combination vehicle.
  - A pressure protection valve to prevent use of air-operated accessories when pressure is below 80 psi except air windshield wipers and steering assist



## Chapter 12-3 Vehicle Components

Quick air buildup - full discharge to moving vehicle within 60 seconds

On a chassis that cannot be equipped with a quick buildup air brake system, an onboard automatic electric compressor or a fire station compressed air shoreline hookup shall be permitted in order to maintain full operating air pressure while the vehicle is not running

## Chapter 12-3 Vehicle Components

Parking brake to hold fully loaded apparatus on at least a **20 percent grade**.

complete stop from 20 mph in a distance not to exceed 35 feet.

Auxiliary braking system on vehicles of 36,000 lb. GVWR or more

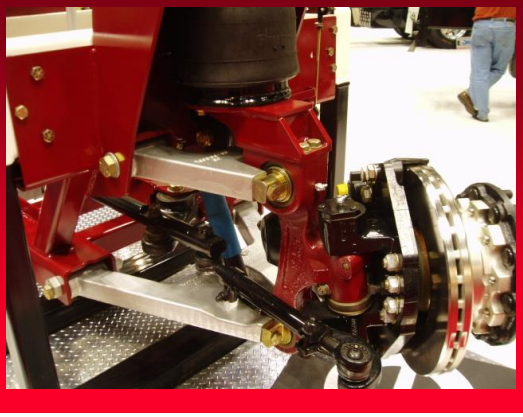
## Chapter 12-3.2 Suspension and Wheels

Axle housings and other non-wheel components shall clear road surface by at least 8 inches

Angle of Approach and Departure of at least 8 degrees

Steering mechanism capable of turning front wheels 30 degrees L or R for non-driving front axles and 28 degrees L or R for driving front axles.

Requirements for tiller steered apparatus - min. cramp angle of tiller wheels 20 degrees R or L.



## Chapter 12-3.2 Suspension and Wheels

- Power steering or power-assisted steering shall be provided

## Chapter 12-3 Vehicle Components

- Transmission

  Shall be rated for heavy-duty service and shall be designed to match engine torque and speed to the load demand.
- Fuel Tank

  Min. fuel for 2 1/2 hr either

  pumping rated capacity at 150 psi or

  60 percent of gross engine horsepower

  which ever is greater

  Fuel fill opening must be clearly marked.

## Chapter 13- Low Voltage Electrical Systems

- The wire shall be stranded copper or copper alloy of a gauge rated to carry 125% of the maximum current for which the circuit is protected.
  - Voltage drops from the power source to the device shall not exceed 10%
  - No star washers on ground connections
- Wiring shall be uniquely identified at least every 2 feet by color coding or permanent marking with a circuit function code

## Chapter 13-3 Power Supply

- At idle, alternator must provide output for the following minimum continuous load with engine compartment temperature at 200ºF
- Minimum continuous load – stationary.
  - Engine and transmission,
  - Clearance and marker lights, headlights,
  - Radio operation-10% transmit / 90% receive,
  - Ground / walking surfaces, control and instrument lights & 50% of compartment lights,
  - Warning lights (block right-of-way per 11-8)
  - Fire pump, aerial, hydraulic pumps
  - Electrical loads critical to mission of apparatus

## Chapter 13-3 Power Supply

- No minimum alternator size
- Low voltage system condition shall be monitored with an audible and visual warning. Alarm shall sound when the system voltage at the battery or master load disconnect switch drops **below 11.8 volts** for 12 v or **23.6 volts** for 24v systems for **more than 120 seconds**.
- Voltmeter within driver's view
- Alt can be 12 or 24 volt

## Load Management

- Load management system required if alternator cannot cover connected load under conditions specified in 13-3.2 (At idle, alternator must provide output for the minimum continuous load with engine compartment temperature at 200°F)
- The minimum continuous electrical loads defined in 11-3.2 shall not be subject to automatic load management

## Chapter 13-4 Batteries

- Batteries shall be of the high-cycle type
- Battery system shall:

– provide minimum continuous electrical load for at least 10 minutes with the engine off

– not discharge by more than 50 percent of the reserve capacity rating

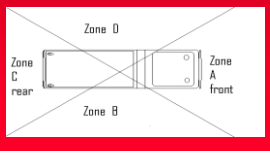
– restart engine

## Chapter 13-8 Optical Warning Devices

- Requirements cover upper, lower, and midship devices
- Four zones per diagram pg. 26
- Two mode optical warning system
  - calling for right-of-way - response
  - blocking right-of-way - on scene
- Switching system
  - Brake off and transmission in drive - call for right-of-way mode
  - Brake on and transmission in park - blockage of-right-of-way

## Chapter 13-8 Optical Warning Devices

| Color | Calling for Right-of-way | Blocking of Right-of-way |
|---|---|---|
| Red | any zone | any zone |
| Blue | any zone | any zone |
| Yellow | **any zone except A** | **any zone** |
| **White** | **any zone except C** | NOT PERMITTED |




## Chapter 13-8 Optical Warning Devices

- Flash rate
  shall be a minimum of **75** flashes per minute
- Permissible colors - see table 13.8.12.1
- Requirements for Large Apparatus
  Bumper-to-bumper length of 25 ft. or greater or optical center greater than 8 ft. above ground level:
  **Upper-level** optical warning devices will be mounted as high as possible on the corners of the apparatus per manufacturer's specifications.
  **Lower-level** optical devices shall be mounted forward of the front axle and behind the rear axle centerlines and as close to the corners as possible; between 18 in. and 62 in. above ground level.

## Chapter 13 Optical Warning Devices

A midship optical warning device shall be mounted on both sides of the apparatus with the optical center between 18 in. and 62 in. **if the distance between the front and rear lower-level optical devices exceeds 25 ft.** Additional devices may be necessary to maintain centers of 25 ft. or less.

## Chapter 13-8 Optical Warning Devices

- Requirements for Small Apparatus

Bumper-to-bumper length of less than 25 ft. and optical center 8 ft. or less above ground level:

**Upper-level** optical warning devices will be mounted as high as possible on the corners of the apparatus but not over 8 ft. at the optical center.

**Lower-level** optical devices shall be mounted as close to the front corners as possible; between 18 in. and 48 in. above ground level.

## **Chapter 13-9** Audible Warning Devices

- Audible warning equipment
  - at least one automotive traffic horn
  - one electric or electronic siren
- Air horns, sirens and electronic siren speaker(s) shall be mounted as low and as far forward as practical - **NO roof mounts**.

## **13-10** Work lighting

- Area behind vehicle 10 x 10 and the hose bed shall be illuminated to at least 3 foot-candles.
- 1 foot-candle illumination on ground around apparatus within 30 in. of the edge in areas designed for personnel ingress and egress of the vehicle.
  - Driver and crew exit areas shall be activated when the doors are opened.
  - All other areas are switchable.

## 13-11 Hazard Light

- **Red flashing or rotating light, located in driver compartment, shall illuminate automatically when ever the parking brake is not fully engaged and:**
- **any passenger or equipment door is open,**
- **ladder or equipment rack is not secured,**
- **stabilizer system not stowed,**
- **power light tower extended,**
- **any device is open, extended, or deployed that creates a hazard**
- **Sign - "Do Not Move Apparatus When Light Is On."**

## Door open or equipment rack down

## Other devices

- Backup Alarm
  - Electric or electronic backup alarm shall be provided - **87 dBA**
- Stop, Tail, and Directional Lights
  - Shall be equipped per Federal Motor Vehicle Safety Standard and mounted equipment shall not obstruct
  - Directional signal visible from front, rear, and sides
  - Apparatus **30 ft.** or longer shall have a turn signal mounted approximately midway along the apparatus at running board height

## 13-14 Electrical System Performance Test

- The apparatus low-voltage electrical system shall be tested and certified.
  - Certification shall be delivered to purchaser.
- Test Sequence
  - Three tests - fully charge batteries before each test.
- Reserve Capacity
  - Warm engine to normal operating temperature - stop.
  - Activate the minimum continuous load for 10 minutes
  - Turn off all loads
  - Re-start engine - battery system shall be capable of re-start the engine - if not TEST FAILURE

## 13-14 Electrical System Performance Test

- Alternator Performance Test at Idle
  - Minimum continuous load activated at idle
  - Stabilize engine temperature
  - Test for presence of battery discharge current
  - Any discharge is **FAILURE**

## 13-14 Electrical System Performance Test

- Alternator Performance Test at Full Load
  - Activate total continuous electrical load with engine running up to the governed speed
  - Test is for **2 hours**
  - Activation of load management is permitted
  - Alarm for low voltage, 11.7v or 23.4v for more than 120 seconds is a failure

  - This is done during the pump capacity test

## 13-14 Electrical System Performance Test

- Low-Voltage Alarm Test
  - **Following previous test, shut down the engine**
  - **Apply continuous electrical load until low-voltage alarm sounds**
- Battery voltage is measured with load still applied.

**The test is a failure if the alarm has not sounded after 140 sec after the voltage has dropped to 11.70v for a 12v system or 23.4 for a 24v system.**

- The battery system shall then be able to restart the engine.
  - **Failure to start is a failure of the test.**

## Chapter 14 - Driving and Crew Area

- **fully enclosed**
- **A label that states the number of personnel the vehicle is designed to carry shall be visible to the driver**
- **Seat belts designed to accommodate a person with and without heavy clothes**
- **If available from the MFG the seatbelts shall be bright red and the buckle shall be mounted on a rigid or semi rigid stalk.**

## Chapter 14 - Driving and Crew Area

- Each seating position not intended to be used during transit shall be individually labeled with a warning that states: THIS SEAT IS NOT TO BE OCCUPIED WHILE VEHICLE IS IN MOTION
- All cab doors shall have at least 96 sq. in. of reflective material affixed to the inside of each door
- Maximum noise level of 90dba w/out warning devices in operation

## **Chapter 14** - Driving and Crew Area *

- **14.1.3.10** A seat belt warning system shall be provided.
- **14.1.3.10.1** The warning system shall consist of an audible warning device that can be heard at all seating positions designed to be occupied while the vehicle is in motion and a visual display visible to the driver or the officer showing the condition of each seating position.

## **Chapter 14** - Driving and Crew Area *

- **14.1.3.10.2** The warning shall be activated anytime the parking brake is released or the automatic transmission is not in park.

## **Chapter 14** - Driving and Crew Area *

- **14.1.3.10.3** The seat position display shall indicate conditions in accordance with Table 14.1.3.10.3.

**Table 14.1.3.10.3 Display for Seating System**

| Display Indication | Seat Belt Sensor | Seat |
|---|---|---|
| Affirmative indication occupant | Buckled | Senses |
| Negative indication occupant | Buckled | No |
| Negative indication occupant | Unbuckled | Senses |
| Dark | Unbuckled | No occupant |

## **Chapter 14** - Driving and Crew Area *

- **14.1.3.10.4** The display indication shall be permitted to consist of lights, text, graphical indicators, digital displays, or other methods.
- **14.1.3.10.5** The warning system shall not show an affirmative indication unless it has determined that the seat was occupied before the seat belt was buckled.

## **Chapter 14** - Driving and Crew Area *

- **14.1.8.4*** The following statement shall be included in the operator's manual: "Fire helmets shall not be worn by persons riding in enclosed driving and crew areas. Fire helmets are not designed for crash protection and they will interfere with the protection provided by head rests. The use of seat belts is essential to protecting fire fighters during driving."
- **14.1.8.4.1** A location for helmet storage shall be provided.

## **Chapter 14** - Driving and Crew Area *

- **14.1.8.4.2** If helmets are to be stored in the driving or crew compartment, the helmets shall be secured in compliance with 14.1.11.2.
- **14.1.8.4.3** A label stating "DO NOT WEAR HELMET WHILE SEATED" shall be visible from each seating location

## **Chapter 14** - Driving and Crew Area

**SCBA units mounted in the cab must have a positive latching mechanism to hold it in place. It shall be designed such that the SCBA cannot be retained in the mount unless the positive latch is engaged.**

- **The bracket holding the device and it's mounting shall retain the SCBA unit when subjected to a 9G force and shall be installed per MFG requirements.**

## **Chapter 14** - Driving and Crew Area

- Any interior area to be occupied by personnel shall have a minimum of two means of escape.

## **Chapter 14** - Driving and Crew Area

- Cab Tilt Systems
  - If cab tilt is hydraulic - device to prevent motion of the cab in the event of a hydraulic hose failure
- Powered tilt shall only work with parking brake is engaged.
- Mechanical means to hold the cab in the tilt position. Mechanical means also needed to hold if a defined intermediate position is also provided.

## **Chapter 14-3** Driving and Crew Area

- **Fully enclosed driving compartment and seating arrangement for not less than 2 persons**
- **Drivers seat adjustment**
- **The following instrumentation is required and must be visible from the driver's position:**
  - **Speedometer**
  - **Tachometer**
  - **Odometer**
  - **Oil pressure gauge**
  - **Coolant temperature gauge**
  - **Automatic transmission temp. gauge**
  - **Voltmeter**

**continued**

## **Chapter 14-3** Driving and Crew Area

- **Hazard indicator light**
- **Air pressure gauges**
- **Turn signal controls and indicator lights**
- **High beam headlight switch and indicator**
- **Fuel level gauge**
- **Master ignition switch**
- **Heater/ defroster controls**
- **Warning lights and siren switches**
- **Master electrical load switch**
- **Battery ON indicator light**
- **Windshield wipers and washer controls**
- **PTO engaged indicator if applicable**
- **Height of vehicle sign**
- **Pump controls, if applicable**

## **Chapter 15 –** Body, Compartments & Equipment *

- The maximum stepping height shall not exceed 18" except for the first step to ground which shall not exceed 24"

## **Chapter 15 –** Body, Compartments & Equipment *

- Steps shall be of such shape that a 5” dia. Disk does not overlap any side when placed on the step.

## **Chapter 15 –** Body, Compartments & Equipment *

- All platforms shall have a minimum depth of 8” from the leading edge. All ladders shall have at least 7” of clearance between rung and body.

## Chapter 15 Body, Compartments, and Equipment Mounting

- **Any enclosed external compartments shall be weather resistant and ventilated and have provisions for drainage of moisture**

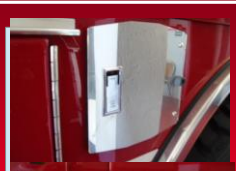
- **Radio Space. A protected space or compartment shall be provided for the installation of radio equipment.**

## Chapter 15 Body, Compartments, and Equipment Mounting

- **Powered Equipment Rack**
- **Lock to retain in travel position**
- **Controls so that operator can see rack while in motion**
- **Flashing lights to front and rear when rack is down**

## Chapter 15 Body, Compartments, and Equipment Mounting

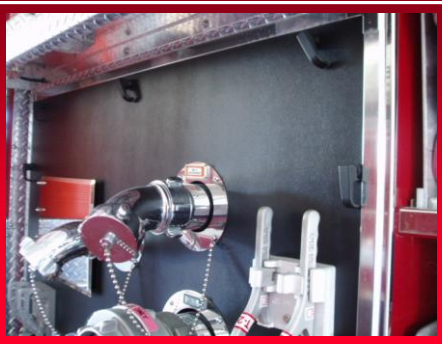
- SCBA storage requirements
  - **Positive latch**
  - **Tubes and racks designed to secure cylinder and protect from excessive movement**



## **Chapter 15 -** Body, Compartments & Equipment Mounting

- Pump and plumbing access panel
  - Quick access 450 sq. in. - no dimension less than 18 in.
  - No special tools
- All valve, gauges, controls, and other plumbing equipment shall be accessible for service and replacement
- The clear space required by the pump MFG to perform in-truck overhaul and maintenance shall be provided

## Access panel



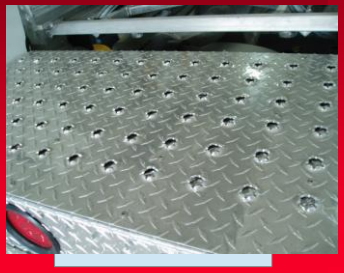
## **Chapter 15** - Body, Compartments & Equipment Mounting

**All steps, platforms, or ladders minimum static load 500 lbs. Without deformation**

## **Chapter 15** - Body, Compartments & Equipment Mounting

**Slip Resistance**

**All materials used for exterior steeping standing or walking surfaces shall have a minimum slip resistance in any direction of 0.68 when tested wet using the English XL Tester**



## **Chapter 15 -** Body, Compartments & Equipment Mounting

- **Access Handrails**

Access handrails shall be 1” and 1 5/8” in dia. And have a minimum clearance of 2” between rail and surface. All rails shall be mounted to reduce the possibility of hand slippage and to avoid snagging of hose, equipment, or clothing.

## **Chapter 15 -** Body, Compartments & Equipment

- Metal Finish
- All exposed ferrous metal surfaces that are not plated or stainless steel shall cleaned prepared and painted or coated
- Reflective striping - min. 4” wide
  - 50% of the cab and body length on each side and 50% of the width of the rear
  - 25% of the width of the front
  - Graphic design is allowed as long as the coverage is correct

## **Chapter 15 -** Body, Compartments & Equipment Mounting *

- **15.9.3.2** At least 50 percent of the rear-facing vertical surfaces, visible from the rear of the apparatus, excluding any pump panel areas not covered by a door, shall be equipped with retro-reflective striping in a chevron pattern sloping downward and away from the centerline of the vehicle at an angle of 45 degrees

**Chapter 15** - Body, Compartments & Equipment Mounting *

- **15.9.3.2.1** Each stripe in the chevron shall be a single color alternating between red and either yellow, fluorescent yellow, or fluorescent yellow-green.
- **15.9.3.2.2** Each stripe shall be 6 in. (150 mm) in width

**Chapter 15** - Body, Compartments & Equipment Mounting *

- **15.9.3.3** All retro-reflective materials required by 15.9.3.1 and 15.9.3.2 shall conform to the requirements of ASTM D 4956, *Standard Specification for Retro-reflective Sheeting for Traffic Control*, Section 6.1.1 for Type I Sheeting.
- **15.9.3.3.1** All retro-reflective materials used to satisfy the requirements of 15.9.3.1 that are colors not listed in ASTM D 4956, Section 6.1.1, shall have a minimum coefficient of retro-reflection of 10 with observation angle of 0.2 degrees and entrance angle of -4 degrees.

**Chapter 15** - Body, Compartments & Equipment Mounting *

- **15.9.3.3.2** Fluorescent yellow and fluorescent yellow-green retro-reflective materials used to meet the requirements of 15.9.3.2 shall conform to the minimum requirements specified for yellow Type I Sheeting in ASTM D 4956, Section 6.1.1.

- **15.9.3.3.3** Any printed or processed retro-reflective film construction used to meet the requirements of 15.9.3.1 and 15.9.3.2 shall conform to the standards required of an integral colored film as specified in ASTM D 4956, Section 6.1.1

## **Chapter 15 -** Body, Compartments & Equipment Mounting

- Receivers and Anchors for Rope and Removable Winches
- Receivers or anchors installed at any location on the apparatus for use as removable winch anchors shall provide at least 1.5 to 1 safety factor over the load rating of the winch
- Receivers or anchors used with rope operations must provide at least 5 to 1 safety factor over the rope.

## **Chapter 15** Driving and Crew Area

- Tractor-Drawn Vehicles
- Driver compartment instrumentation
- Heater/defroster controls
- Turn signal indicators
- Two-way buzzer signal switch
- Windshield wiper and washer controls

## **Chapter 16 -** Fire Pumps

Requirements for pumps to 3000 gpm

- Design and Performance

  Min. capacity of 250 gpm at 150 psi
- Pump and roll - 20gpm at 80psi on level ground at 2 mph
- Pumping System Capability
- 100% of rated capacity at 150 psi NPP

  70% of rated capacity at 200 psi NPP

  50% of rated capacity at 250 psi NPP

## **Chapter 16** - Fire Pumps

- Dry pump must be capable of taking suction through 20 ft. of suction hose and discharging water in not more than 30 seconds for pumps of less than 1500 gpm and not more than 45 seconds for pumps of 1500 gpm or larger.
- Completed pumping system shall be capable of developing a vacuum of 22 in. Hg and sustaining for at least 5 min. with a loss not to exceed 10 in. Hg.

## **Chapter 16** - Fire Pumps

- The priming device shall be capable of operating with no lubricant or with a biodegradable nontoxic lubricant

## **Chapter 16-3** Pumping Engine Requirements

- **Pumps of 750 gpm or greater, the engine/pump combination shall be capable of delivering the rated capacity at 165 psi NPP - (Over-load test)**
- **A supplemental heat exchanger cooling system shall be provided for the pump drive engine. No water intermixing.**
- Power Train Capability
- **When the capability exist for the engine and pump combination to exceed the manufacturer's continuous duty torque rating, a means to limit the engine output to a level equal to or below the specification shall be provided.**

## Chapter 16-5 Construction Requirements

- **Pump body hydrostatic test of 500 psi minimum for 10 minutes. Pump manufacturer provides certification.**
- **Entire discharge and intake piping, valves, drain cocks and lines, and intake and outlet closures, excluding the tank fill and tank to pump lines on the tank side of the valves, shall be capable of withstanding a minimum hydrostatic pressure of 500(250 new) psi.**

## 16-6 Pump Intake Connections

- **Intakes of the same or larger and quantity than the maximums specified in Table 16.7.1 for suction hose size and number of suction lines shall be provided.**
- **Any 3 in. or larger intake valve shall be a slow-operating valve.**
- **Valved intakes to have a bleeder valve of 3/4 in. minimum**
- **Valved intakes of 3 1/2 in. or larger will be equipped with an adjustable automatic pressure relief device - which shall discharge to atmosphere.**

## 16-7 Pump Discharge Outlets

- Inlets equipped with a valve, siamese or adaptor that remains in place while the apparatus is in motion shall not project beyond the running board
- Discharge outlets of 2 1/2 in. or larger shall be provided to discharge the rated capacity of the pump at the flow rates

## 16-7 Pump Discharge Outlets

- A minimum of 2 - 2 1/2 in. outlets shall be provided for any pumps rated at 750 gpm or greater and 1 - 2 1/2 in. outlet for pumps rated at less than 750 gpm.
- All 1 1/2 in. or larger discharge outlets shall have a minimum of a 3/4 in. drain or bleeder.

## 16-7 Pump Discharge Outlets

- Piping and valves supplying any preconnected 1.5", 1.75",or 2" hose line shall be at least 2" in size
- Each discharge outlet shall be equipped with a valve that can be opened and closed smoothly at flows in table 16.7.1 at pump gauge pressures of 250psi

## 16-7 Pump Discharge Outlets

- **Any 2 in. or larger discharge outlet that is located more than 42 in. above the ground shall be supplied with a sweep elbow of at least 30 degrees downward**
- **No discharge outlet larger than 2 1/2 in. shall be located at the pump operator's panel.**
- **Position indicator req'd for valve control**

## Position indicator req'd for valve control

## Chapter 16.10 Pump Controls

- Where engine compression or exhaust braking are furnished these engine brakes shall be automatically disengaged for pumping operation
- When using a split shaft PTO for pumping the driving compartment speedometer shall register when the pump drive system is engaged
- Chassis transmission retarders shall be automatically disengaged for pumping operation

## Chapter 16.10 Pump Controls

- Where the pump is driven by the chassis engine and is equipped with an automatic transmission an interlock shall be provided to ensure that the system is engaged in the pumping mode of operation
- A Pump Engaged light to indicate the pump has shifted completely

## Chapter 16.10 Pump Controls

- An OK to Pump light shall be provided in the driving compartment to indicate the pump is engaged the transmission is in pump gear and the brakes are set

## Chapter 16.10 Pump Controls

- A Throttle Ready ligh shall be provided at the operators panel that th apparatus is in OK to Pump mode.

## Chapter 16.10 Pump Controls

- **Pump Operator Panel Engine Speed Advancement, An interlock system shall be provided to prevent advancement of the throttle at the panel unless the apparatus is in OK to Pump Mode**
- **Whether the apparatus is equipped with a relief valve or a engine governor it shall have a indicator to show that it is turned on and if it is in control of the pressure**

## **Chapter 16-10** Pressure Control System

- A system shall be provided that will automatically control the discharge pressure to a maximum of 30 psi pressure rise above the set pressure when all discharges are closed no more rapidly than 3 seconds or slower than 10 seconds during the following conditions:
  1. Range of pressure 90psi - 250psi NPP

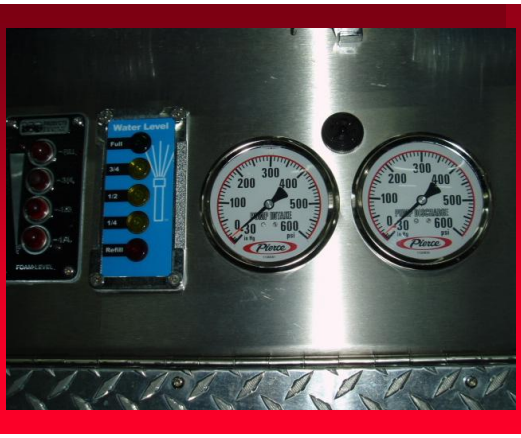
1.Range of flows 150 gpm to capacity of pump

## **Chapter 16-12** Instrumentation

- Main pump control grouping
  - **Master intake and discharge gauges**
  - **Tachometer, voltmeter**
  - **Coolant temperature, oil pressure**
  - **Throttle, pressure control, primer**
  - **Tank-to-pump & tank-fill control**
  - **Tank level indicator**
- Grouped to keep the operator as far as practical from hose outlets or inlets

## Chapter 16-12.2 Master Pump Intake and Discharge Pressure Indicating Devices

- **Master pump intake and pump discharge pressure indicating devices shall be located within 8 in. of each other, with the intake device to the left or below and the discharge device to the right or above.**
  - **Intake pressure indicating device shall read from 30 in. Hg vacuum to at least a gauge pressure of 300 psi. Shall be marked "Pump Intake"**
  - **The discharge pressure indicating device shall read from a gauge pressure of 0 psi or lower to a gauge pressure of at least 300 psi. Shall be marked "Pump Discharge"**



## Chapter 16-12.2 Master Pump Intake and

- At least a 1” diameter differential in viewing area between the master and individual discharge gauges
- Numerals for master gauges shall be a minimum of ¼” high
- Marked at least every 10psi
- If digital gauges are used at least ½” high numerals and display in increments of not more than 10psi

## **Chapter 16-12.2** Master Pump Intake and

- Pressure or flow indicating devices no more than 6" from valve control centerline

## Chapter 16.12.3 Discharge Outlet Instrumentation

- A flow meter or pressure gauge shall be provided for each discharge 1.5" or larger outlet and shall be labeled to the outlet to which it is connected
- Any 3.5" or larger outlet equipped with a flow meter shall also have a pressure gauge
- Flow meters shall display flow in increments no greater than 10 GPM

## **16-13** Required Testing

- Pumps of 750gpm or greater:
  - Pumping test (16-13.2)
  - Pumping engine overload test (16-13.3)
  - Pressure control systems test (16-13.4)
  - Priming device test (16-13.5)
  - Vacuum test (16-13.6)
  - Tank to pump test (16-13.7) if equipped w/tank
- Pumps of less than 750 gpm
  - same as above except - NO OVERLOAD TEST

## 16-13 Required Test

- A test plate shall be provided at the pump panel with the rated discharges and pressures together with speed of the engine as determined by the certification test
- Position of the parallel / series switch as used, the no load governed speed of the engine

## 16-13 Required Test

- Conditions for test

**Water at least 4 ft. deep; water level no greater than 10 ft. below centerline of pump intake; 20 ft. of suction hose; strainer at least 2 ft. below surface of the water.**

**Air temperature: 0ºF to 110ºF**

**Water temperature: 35ºF to 90ºF**

**Barometric pressure: 29 in. Hg**

**All accessories shal be functional.**

## 16-13 Required Test *

- **16.13.2.1.4.2** If the vehicle is equipped with a fixed power source driven by the same engine that drives the fire pump, it shall be running at a minimum of 50 percent of its rated capacity throughout the pumping portion of the pump test.

## 16-13 **Required** Test *

- **16.13.2.1.4.3** The following devices shall be permitted to be turned off or not operating during the pump test:
  - (1) Aerial hydraulic pump
  - (2) Foam pump
  - (3) Hydraulically driven equipment (other than hydraulically driven line voltage generator)
  - (4) Winch
  - (5) Windshield wipers
  - (6) Four-way hazard flashers
  - (7) Compressed air foam system (CAFS) compressor

## 16-13.2.3.1 Pumping Test

- **750 gpm or greater pump - 3 hour test**
  - **2 hours continuous pumping at rated capacity at 150 psi**
  - **1/2 hour continuous pumping at 70% of rated capacity at 200 psi**
  - **1/2 hour continuous pumping at 50% of rated capacity at 250 psi**
  - **NO stopping pump until after the 2 hour test, except to clear the strainer**
- **Less than 750 gpm pump 50 minute test**
  - **1/2 hour continuous pumping at rated capacity at 150 psi**
  - **10 minutes of continuous pumping at 70% capacity at 200 psi**
  - **10 minutes of continuous pumping at 50% capacity at 250 psi**

## Pump Testing

- Pumping Engine Overload Test

  Pump rated at 750 gpm or greater
  - **Pumping rated capacity at 165 psi for at least 10 minutes.**
  - **Test is to immediately follow the rated capacity test at 150 psi**

## 16.13.4 Pressure control system test

- The pump shall be operating at draft delivering 100% rated capacity at 150psi nnp
- Set the pressure control device according to MFG to maintain 150 psi
- Close all discharge valves no faster than 3 sec no slower than 10 sec
- The rise in discharge pressure shall no exceed 30 psi

## 16.13.4 Pressure control system test

- Reopen the valves and adjust to establish original pressure and flow
- Decrease throttle to lower discharge pressure to 90 psi
- Reset pressure control device to maintain 90psi
- Close all discharges same as before, pressure setting can not rise more than 30 psi

## 16.13.4 Pressure control system test

- The device is tested again during the 50% @ 250psi test
- Set the pressure control device at 250psi close the valves as before the pressure shall not rise more then 30psi

## 16.13.5 Priming Device Test

- This test shall be permitted to performed in connection with priming the pump for the pumping test
- Time the interval from the time the primer is started until the primer pump is discharging water
- For pumps less than 1500gpm the time is 30 sec.
- For pumps 1500gpm or greater the time is 45 sec.

## 16.13.5 Priming Device Test

- An additional 15 sec shall be permitted if the pump system includes an aux. 4" or larger intake pipe having a volume of 1 cubic foot or more

## 16.13.6 Vacuum test

- Vacuum test shall be conducted as follows: with intake valves open and capped
- Discharge valves closed and uncapped
- A vacuum of at least 22"hg shall be established by means of the priming device
- The vacuum shall not drop more than 10"hg in 5min

## 16.13.7 Water Tank to Pump Flow Test

- If the water tank has a certified capacity of LESS than 500gal. It shall be capable of delivering water at a minimum rate of 250gpm
- If the water tank has a certified capacity of 500gal. or Greater it shall be capable of delivering water at a minimum rate of 500gpm or the rated capacity of the pump whichever is less

## 16.13.7 Water Tank to Pump Flow Test

- The rated tank to pump flow rate shall be maintained until 80% of the tank capacity has been discharged

## 16.13.7 Water Tank to Pump Flow Test

- Test sequence is as follows (short version)
- Connect the correct size nozzle and hose for the amount of gpm to be discharged.
- Open tank to pump valve, then open discharge with hose and nozzle attached
- Adjust throttle to get proper nozzle pressure
- Close discharge and open tank fill to circulate water, fill tank from external source until it overflows

## 16.13.7 Water Tank to Pump Flow Test

- Close external source and close tank fill valve
- Open same discharge valve fully and reset throttle as necessary to maintain correct pressure
- Record the amount of time from opening the discharge to the time pressure drops by 10psi or more and cavitations begins

## 16.13.7 Water Tank to Pump Flow Test

- Convert gallons per minutes to gallons per seconds
- Multiply the number of GPS by the total number of seconds to reach total gallons flowed
- Total number of gallons flowed must be 80% or more of tank volume

## Water Tank to Pump Flow Test

1" tip @ 72psi = 251 gpm
251gpm is = to 4.18 gal per sec

1.5" tip @ 58psi = 508 gpm
508gpm is = to 8.56 gal per sec
Gal per sec times total time in sec =
Total gallons
Must be at least 80% of tank volume

## Water Tank to Pump Flow Test

For tanks less than 500 gallons 80% of tank capacity @ 250 Gpm.

Using a 1” tip @ 72psi = 251 Gpm

Ex. 300 gal. tank 80% = 240 gal.

At 251gpm it will take 57.41 sec to pump 240 gal. or 80% of 300 gal.

## Water Tank to Pump Flow Test

1” tip @ 72psi = 251gpm

251 divided-by 60sec = 4.18 gps

80% of 300gal = 240gal

240gal divided-by 4.18gps = 57.41sec

## Water Tank to Pump Flow Test

500gal tank 80% @ 500gpm

80% of 500 = 400gal

1.5” tip @ 58psi = 508 gpm

508gpm divided-by 60 = 8.46gps

To flow 400gal @ 8.46gps = 47.28 sec

## Water Tank to Pump Flow Test

1000gal tank  80% @ 500gpm
80% of 1000 = 800gal
1.5” tip @ 58psi = 508 gpm
508gpm divided-by 60 = 8.46gps
To flow 800gal @ 8.46gps = 94.56 sec

## Chapter 17 - Auxiliary Pumps

- Auxiliary pumps shall be rated as either High pressure or Medium pressure
- A High pressure aux. pump shall be a minimum of 66gpm @ 600psi
- Medium pressure Aux. pump shall have one of the following ratings 30gpm, 60gpm, 90gpm, 120gpm, 250gpm, or 350gpm

## Chapter 17 - Auxiliary Pumps

- The pump shall be capable of pumping.

100% capacity @150psi
70% capacity @ 200psi
50% capacity @ 250psi

- 17.2.4 The rating for auxiliary pumps shall be based on the pump taking water from the apparatus water tank

## Chapter 17 - Auxiliary Pumps

- The power train for the pump must be capable of 50 minutes pumping rated capacity and pressure.
- Construction
  - Hydrostatic test pressure of the pump piping and valves shall be at least 100 psi above maximum system operating **pressure.**
  - Backflow prevention between aux. pump and fire pump
- Relief valve or pressure control when two or more outlets
- Same requirements as fire pumps for valves, instruments, etc.

## Chapter 17 Industrial Supply Pumps

- The industrial supply pump shall be mounted on the apparatus and shall have a minimum rated capacity of 3000gpm @ 100psi npp
- A label that states " *This apparatus is equipped with an industrial supply pump that has a different performance envelope than a fire pump"*
- The pumping system shall be capable of delivering
  - 100%@ 100psi npp
  - 70% @ 150psi npp
  - 50% @ 200psi npp

## Chapter 17 Industrial Supply Pumps

- The pump system shall be capable of taking suction through 20ft of suction hose in not more than 45 sec.
- All other test same as Fire Pump tests

## Chapter 18 - Water Tanks

- All water tanks shall be constructed of noncorrosive material
- Water tanks shall have a means to permit cleaning
- If tank is independent of the body it shall be equipped with a method for lifting off the chassis

## Chapter 18 - Water Tanks

- Tanks shall be cradled, cushioned or spring mounted to protect it from stress
- Cleanout sumps one or more shall be provided
- A 3” or larger removable pipe plug shall be furnished in each sump

## Chapter 18 - Water Tanks

- An indicator shall be provided that shows the level or amount of water in the tank
- A fill opening shall be designed to allow the insertion of a 2.5” hose with coupling
- Tank fill line, water tanks of 1000 gallons or less shall have at least a 1” fill line

## Chapter 18 - Water Tanks

- Water tanks with a capacity of over 1000 gallons or more shall have at least a 2” fill line
- A valve shall be capable of regulating the flow into the tank and shall be controllable from the pump panel

## Chapter 18 - Water Tanks

- Mobile water supply apparatus shall have an external fill connection leading directly into the tank
- The external fill shall have a minimum fill rate of 1000gpm
- Water tank capacity certification, the mfg shall certify the capacity of the water tank and provide a record to the purchaser

## Chapter 19 - Aerial Devices

- Aerial ***LADDER*** Requirements
- Minimum rated height of at least 50ft.
- Rungs equally spaced a max. of 14” and a minimum of 11.75” apart
- A minimum design load of 500# per rung
- A minimum of 18” in width inside the rails

## Chapter 19 - Aerial Devices

- Top rails shall be provided, shall be 1" minimum width and shall be at a minimum height of 12" above the rungs
- Folding step at the top of the ladder shall be provided for the ladder pipe operator to stand, minimum load 500#

## Chapter 19 - Aerial Devices

- An Arial ladder with a vertical height of 110' or less, with stabilizers set shall be capable of being raised from the bedded position to maximum elevation and extension and rotated 90 degrees within 120 seconds. Two or more of these functions shall be permitted to be performed simultaneously.
- Aerial ladders over 110' shall meet these requirements within 180 seconds

## Chapter 19 - Aerial Devices

- Covers aerial ladders, elevating platforms & water towers
- Aerial Ladder - 250 lb. capacity minimum
- Elevating platform - 750 lb. capacity minimum
- Rated in 250 lb. increments
- Interlocks required to prevent premature movement

## Chapter 19 - Aerial Devices

- Controls at the operators position shall be lighted, and marked with a label, and conveniently arranged to allow the operator to perform the following
  - Elevate and lower the aerial device
  - Extend and retract the aerial device
  - Operate the aerial device in either direction
  - Operate the intercom

## Chapter 19 - Aerial Devices

- Some requirements different if aerial device over 110 ft.
- New requirements if operating controls at tip of aerial ladder
- Breathing air now optional for platforms
- Waterway - 1000 gpm at 100 psi at nozzle with max. 100 psi friction loss

## Chapter 19 - Aerial Devices

- An interlock that prevents operation of the aerial device until the parking brake is set and the transmission has been placed in neutral or the transmission is in the drive position with the driveline to the rear axle disengaged i.e. pump in gear
- An interlock system shall be provided to prevent rotating the aerial until the stabilizer(s) is in a configuration to meet the stability requirements of section 18-21 the interlock system shall also prevent the movement of the stabilizers unless the aerial device is in the travel position

## Chapter 19 - Aerial Devices

- Hydraulic systems
- Nonsealing moving parts of all hyd. Components whose failure results in motion of the aerial device shall have a minimum bursting strength of FOUR times the maximum operating pressure to which the component is subjected
- Dynamic sealing parts shall not begin to extrude or otherwise fail at pressures at or below TWO times the maximum pressure to which it is subjected.

## Chapter 19 - Aerial Devices

- Static sealing parts whose failure results in motion shall have a minimum bursting strength of FOUR times the maximum operating pressure it is subjected to.
- All hydraulic hose, tubing, and fittings shall have a minimum bursting strength of at least THREE times the pressure it is subjected to.

## Chapter 19 - Aerial Devices

- The hydraulic system shall be provided with a gauge at the lower operating position
- The hydraulic system components shall be capable of maintaining under all operating conditions, oil cleanliness and temperature that complies with the MFG. Recommendations

  The system shall have adequate cooling for continuous operations of 2 ½ hrs. min.

## Chapter 20 - Foam Proportioning Systems

- Seven types of systems covered
- System design requirements are given
- Foam tank design/construction
- Requirements for foam pumps
- Pressure vessels & foam solution tanks
- Foam system piping schematic required
- Accuracy test is required

## Chapter 20 - Foam Proportioning Systems

1) Eductor system
2) Self-educting master stream nozzle
3) Intake-side system
4) Around-the-pump system
5) Balanced pressure system
6) Direct injection system
7) Water powered direct injection foam proportioning system

## Chapter 20 - Foam Proportioning Systems

- Components that are continuously wetted with foam concentrate shall be constructed of materials that will not be damaged in form, fit, or function when exposed to foam concentrates
- Foam concentrate supply line shall not collapse under any operating conditions
- A means shall be provided to prevent water backflow into the foam proportioning system and the foam tank

## Chapter 20 - Foam Proportioning Systems

- A foam concentrate system flush line shall be provided as required

A means shall be provided in the flush line to prevent water backflow into the foam tank or water tank

Systems connected to more than one tank provisions shall be made to flush all common lines to avoid contamination of dissimilar foam concentrates

## Chapter 20 - Foam Proportioning Systems

Atmospheric foam Concentrate Tank

The foam tank shall be constructed of noncorrosive materials

Shall be provided with swash partitions

The tank shall be provided with a fill tower or expansion compartment having a minimum area of 12sq.in and having a volume of not less than 1% of total tank volume

- The fill tower shall be protected by a completely sealed airtight cover.
- The cover shall be attached by a mechanical means.

## Chapter 20 - Foam Proportioning Systems

- It shall incorporate a removable screen with a mesh not to exceed ¼" holes
- It shall be arranged so that foam concentrate from a 5-gal container can be dumped directly to the bottom of the tank to minimize aeration without the use of funnels or other special devices

## Chapter 20 - Foam Proportioning Systems

- The fill tower shall be equipped with a pressure/vacuum vent that enables the tank to compensate for changes in pressure or vacuum when filling or withdrawing foam concentrate from the tank.

## Chapter 20 - Foam Proportioning Systems

- The pressure/vacuum vent shall not allow atmospheric air to enter the foam tank except during operation or to compensate for thermal fluctuations. The vent shall be protected to prevent foam concentrate from escaping or directly contacting the vent at any time. The vent shall be of sufficient size to prevent tank damage during filling or foam withdrawal

## Chapter 20 - Foam Proportioning Systems

- The foam concentrate tank shall not be equipped with an overflow pipe or any direct opening to the atmosphere
- The tank shall be designed for compete flushing and cleaning
- A minimum 1" (½") drain valve shall be provided at the lowest point of the tank
- Tank shall be independent of the apparatus body

## Chapter 20 - Foam Proportioning Systems

- Labels at or near tank fill "Foam Tank Fill" and "Warning: Do Not Mix Brands and Types of Foam"
- The tank outlet connection shall prevent aeration of concentrate and shall allow withdraw 80% of tank capacity under all operating conditions on level ground

## Chapter 20 - Foam Proportioning Systems

Foam Concentrate Pump

- The pump shall operate without cavitation at maximum rated flow
- Pump construction materials shall be corrosion-resistant and compatible with the type of foam being used
- A means to relieve excess pressure in the pumping system shall be provided to protect the pump from damage

## Chapter 20 - Foam Proportioning Systems

Pressure Vessel Foam Tanks

If the tank is charged with compressed gas or a pressurized liquid and it falls with in the scope of the ASME *Boiler and pressure vessel code*, section VIII division ! It shall be designed fabricated and stamped in accordance with the requirements of the ASME

## Chapter 20 - Foam Proportioning Systems

Foam system piping and components shall be designed to withstand a minimum of 1 ½ times the maximum working pressure and shall be tested to the working pressure of the pressure vessel after installation

A relief valve that meets the applicable requirements of ASME shall be installed and set to prevent the vessel pressure from exceeding 110% of the maximum allowable working pressure

## Chapter 20 - Foam Proportioning Systems

A device indicating the internal pressure of the vessel shall be located at the operators panel

## Chapter 20 - Foam Proportioning Systems

Labels, Plates and Instructions

An instruction plate shall be provided that includes at a minimum a piping schematic of the system and basic operating instructions

Each control, gauge shall be marked with a label as to it's function

## Chapter 20 - Foam Proportioning Systems

A plate at the operators position shall be provide the following information

- Foam classification type Class A, Class B, Class A&B
- Types of foam concentrate compatible with system design
- Proportioning rate
- Maximum / minimum water flow gpm
- Maximum / minimum operating pressure

## Chapter 20 - Foam Proportioning Systems

Two copies of an operations and maintenance manual shall be provided

The foam proportioning system shall be accurate throughout the manufacturer's stated range of flow and pressure

The accuracy of the foam proportioning system shall be tested by the apparatus manufacturer prior to delivery of the apparatus

## Chapter 2 - Foam Proportioning Systems

Accuracy of the foam proportioning system continued

- System with ratios of less than 1% shall be accurate to +/- 20%
- Systems with ratios of 1% or greater shall be accurate to –0/+30% or 1percentage point whichever is less

## Chapter 21 - Compressed Air Foam Systems

- System rating includes air/solution mix
- Solution/air has to be balanced automatically
- Engagement time and ease same as water pump
- Automatic backflow prevention required
- Mixer for foam solution/air required
- Pre-delivery tests required

## Chapter 21 - Compressed Air Foam Systems

- Total CAFS rating shall be expressed in terms of air & water flow
- The airflow shall be expressed in Standard cubic feet per minute (SCFM) and shall be based on the continuous flow of the compressed air source at a minimum gauge pressure of 125psi
- The water flow shall be expressed in gallons per minute at a gauge pressure of 125psi

## Chapter 21 - Compressed Air Foam Systems

The apparatus shall be capable of supplying power for operating the CAFS at its rated capacity in addition to all other power dependent systems installed on the apparatus

The water pump and air pressures shall be automatically balanced up to the rated pressure of the air compressor within +/- 10 %

## Chapter 21 - Compressed Air Foam Systems

A means shall be provided for the operator to relieve all pressure from the system after the system has been deactivated

Compressed Air Source

The air source shall provide a continuous supply for 6 hours without needing adjustment, adding lubrication, or changing air filters

## Chapter 21 - Compressed Air Foam Systems

Air Mixing

An automatic means shall be provided to prevent the backflow of all liquids and gases. This shall included backflow of water or foam solution into the compressed air source, air into the water pump and both air and water into the foam proportioning equipment

## Chapter 21 - Compressed Air Foam Systems

Manufacturer's Predelivery Tests

Capacity rating test

Standby run test

Capacity test: the compressed air source shall be operated at its flow capacity at a minimum gauge pressure of 125psi

The water pump shall discharge 2gpm of water at 125npp for every 1 SCFM of compressed air discharge

The discharge shall be through at least two separate discharge openings. One discharging air only the other discharging water only

## Chapter 21 - Compressed Air Foam Systems

One or more lines of sufficient diameter shall be provided to allow discharge of the required amount of water from the pump to the nozzle.

The air flow rate shall be measured using a pressure and temperature compensated flow measuring device. The airflow shall be measured in SCFM at a minimum gauge pressure of 125psi.

## Chapter 21 - Compressed Air Foam Systems

The water pump and the compressed air source shall be started and the rated flows and pressures as specified in 20-9.1.1 shall be maintained. The system shall be run for 1hour.

Readings of the airflow rate and pressure and water pump pressure and discharge rate shall be taken at least every 10 minutes.

## Chapter 21 - Compressed Air Foam Systems

- Failure of any component of the CAFS to maintain air and water pressures and discharge volumes at or above the system rating shall constitute failure of the test.

## Chapter 21 - Compressed Air Foam Systems

Standby run test: (short version) one 200' line with quarter turn valve, establish a foam flow with a output pressure of 125psi. With water tank half full. Close the valve and maintain engine speed for 10 minutes without discharging water, air or foam solution from the CAFS and without operator intervention.

continued

## Chapter 21 - Compressed Air Foam Systems

- After 10 minutes open the valve(slowly) Either damage to the system that effects rated performance of the lack of a fire stream immediately upon opening the hose line shall constitute failure of the test.

## Chapter 22 - Line Voltage Electrical System

- Covers 120-240 volt systems
- Materials and hard wired electrical equipment must be listed for application
- 7 electrical power sources covered
- Covers wiring methods and components
- Requirements for power-operated light masts
- 2 hour test required

## Chapter 2 - Line Voltage Electrical System

Maximum voltage shall not exceed 275 (250) volts =/- 10 %

Any power source producing AC current shall produce power at 60 cycles

All components shall conform to NFPA 70, National electrical Code (NEC) where requirements of this chapter differ from those in the NEC the requirements in this chapter shall apply

## Chapter 22 - Line Voltage Electrical System

Grounding shall be in accordance with section 250-34 “portable and vehicle mounted generators” of the nec.

- Ungrounded systems shall not be used
- Only stranded or braided copper conductors shall be used

Bonding, the neutral conductor of the power source shall be bonded to the vehicle frame. The neutral bonding connection shall only occur at the power source

## Chapter 22 - Line Voltage Electrical System

Seven power sources

- Direct drive (pto) generators
- Hydraulic Driven generators
- Fixed Auxiliary Engine-driven generators
- Belt-driven generators or Alternators supplying a Dedicated inverter
- Line voltage systems derived from apparatus low voltage power supply system
- Portable generator installations
- Line voltage supplied from external source

## Chapter 22 - Line Voltage Electrical System

If the power source is rated at less than 3kw a "Power On" indicator shall be provided

If the power source is rated at 8kw or more, the following instrumentation shall be provided at the operator's panel

- Voltmeter
- Amperage meters for each leg
- Frequency (cycle) meter
- Power source hour meter

## Chapter 22 - Line Voltage Electrical System

Wiring methods

Fixed wiring shall be limited to the following

- Metallic or nonmetallic liquid tight flexible conduit rated at not less than 194deg F
- Type SO or type SEO cord with a WA suffix, rated at 600 volts at not less than 194deg F

## Chapter 22 - Line Voltage Electrical System

- Electrical cord or conduit shall be supported within 6” of any junction box and at a minimum of every 24” of run
- Splices shall be made only in a listed junction box

## Chapter 22 - Line Voltage Electrical System

- Where SO or SEO cable is installed in a compartment it shall be installed on the ceiling surface or shall be enclosed in a metal conduit
- Where cable penetrates a metal surface rubber or plastic grommets or bushings shall be installed

## Chapter 22 - Line Voltage Electrical System

- Only stranded copper conductors with an insulation rated for at least 194deg F shall be used
- NO Aluminum or copper clad aluminum conductors shall be used
- Boxes shall not be permitted behind welded or pop riveted panels
- Switches shall indicate the position of its contact points (open/closed)
- Switches shall be marked as to there function

## Chapter 22 - Line Voltage Electrical System

- Circuit breakers used as switches shall be "switch rated" or better
- Switches shall simultaneously open all associated line voltage conductors

Receptacles

- All receptacles located in a wet location shall be not less than 24" from the ground
- Dry location receptacles shall be not less than 12" (30") above the interior floor height

## Chapter 22 - Line Voltage Electrical System

- The face of any wet location receptacle shall be installed in the vertical plane to not more than 45deg off vertical
- No receptacle shall be installed in a face up position

## Chapter 22 - Line Voltage Electrical System

- Each receptacle shall be labeled with the nominal line voltage(120/240) and the current rating in amps of the circuit
- All receptacles and electrical inlet devices shall be listed to UL 498

## Chapter 22 - Line Voltage Electrical System

Remote power distribution box shall be listed for wet location and shall be as follows

- Protected from corrosion
- Capable of being carried with a gloved hand
- Designed to keep the exterior electrical components above 2” of standing water

## Chapter 22 - Line Voltage Electrical System

Remote power distribution boxes shall have a light on the box to indicate the power is on.

The light shall be visible 360deg. From a minimum of 200’ in complete darkness. The light shall be mechanically protected to prevent damage

## Chapter 22 - Line Voltage Electrical System

Power operated light mast

The mast shall be designed to sustain the intended tip load with at least a 125% safety factor

The mast shall withstand a minimum of 50 mph wind in a raised unguyed position

In the event of a failure of the light towers raising system a means shall be provided to limit the rate of decent in order to prevent damage

## Chapter 22 - Line Voltage Electrical System

A secondary means of control shall be provided to allow for emergency lowering of the mast

An automatic deenergizing means shall be provided so no electrical power to the mast or to the light wiring when the mast is in a stowed position

The hazard warning light required in section 11-11 shall be illuminated whenever the light tower is not in the stowed position

## Chapter 22 - Line Voltage Electrical System

- Electrical System testing

Wiring and equipment shall be tested by the Manufacturer or installer

A dielectric voltage withstand test of 900 volts for 1 minute

Polarity verification test of equipment and receptacles

## Chapter 22 - Line Voltage Electrical System

Operational Test

The prime mover shall be started from a cold start and 100% of the electrical load applied and the following shall be recorded

- Cranking time until prime mover starts and runs
- The voltage, frequency, and amperes at continuous full rated load
- Oil pressure, water temp, transmission temp, and the battery charge rate, as applicable
- The ambient temperature and altitude

## Chapter 22 - Line Voltage Electrical System

The power source shall be operated by the apparatus manufacturer at 100% of the system's continuous rated wattage for a minimum of 2 hours.

The conditions specified in 21-14.4.1 (2&3) shall be recorded at least every ½ hour.

If the apparatus is equipped with a fire pump this 2 hour test shall be completed with the fire pump pumping at 100% capacity @150psi npp.

The 2 hour test shall be permitted to be run concurrently with the pump certification test.

## Chapter 22 - Line Voltage Electrical System

Where line voltage is derived from the vehicles low-voltage system, the minimum continuous electrical load shall be applied.

Any termination of line voltage by the low-voltage load management system shall be noted and the duration of shutdown shall be recorded

## Chapter 23 - Command and Communications

- 25 sq. ft. minimum area
- 80 dba max. noise level with doors closed
- 100 lumens per square foot lighting
- Radio, computer, and video installation
- Climate control
- Seating
- Working surface height and construction

## Chapter 23 - Command and Communications

Climate control shall be provide with a heater capable of maintaining the temp. at a minimum of 60deg. F with doors closed.

If an air conditioner is provided it shall be capable of maintaining a minimum temp of 20deg.F below ambient down to 72deg.F with door closed

## Chapter 23 - Command and Communications

Chair level work surfaces shall be 28” to 30” above the floor,

stand up work surfaces shall be 36” to 40” above the floor

## Chapter 23 - Command and Communications

If seating in the command area is the same that is used for travel they shall comply with section on seatbelts & restraints

## Chapter 23 - Command and Communications

Commutation equipment shall be installed in accordance with the component manufacturer’s instructions

Radio and commutation equipment shall conform to Federal Commutations Commission standards and requirements

## Chapter 24 - Air Systems

- Covers compressors and cascade systems
- Piping and component requirements
- Requirements for instrumentation and labeling
- Air purification
- Air storage
- SCBA fill stations
- Air reels

## Chapter 24 - Air Systems

All pneumatic fittings shall have a safety factor of not less than 4:1

Gauges instruments and valves shall be located and oriented for maximum visibility

All major components and accessories shall be marked with a label. Caution and warning signs shall be affixed where necessary

## Chapter 24 - Air Systems

Compressor air intake shall be located where it will not be contaminated by the exhaust of the vehicle or the engine used to power the compressor or other components on the apparatus

## Chapter 24 - Air Systems

All compressors shall have automatic audible and visual alarms and controls that shut down the compressor and prevent automatic restart when any of the following conditions occur

- Low oil level or pressure
- Discharge air temperature is higher than recommended by the MFG
- Moisture in the compressed air at the purification system outlet exceeds 25ppm
- Carbon monoxide level within the processed air exceeds 10ppm

## Chapter 24 - Air Systems

If the processed air is to be used for firefighting it shall meet the requirements of Grade D breathing air as specified by CGA G-7 and NFPA 1500

If the processed air is to be used for underwater diving (SCUBA) if shall meet the requirements of Grade E breathing air as specified by CGA G7

## Chapter 24 - Air Systems

The air purification system shall be capable of producing the required air quality at full capacity of the compressor for a minimum of 50 hours with inlet air of 80deg.F at saturation

## Chapter 24 - Air Systems

- Air tanks (dot or ASME) shall comply with 29 CFR 1910.169 “air receivers”
- Air tanks shall be permanently stamped or identified in accordance with DOT or ASME regulations
- If DOT cylinders are used a label shall be placed on or near the operator’s panel that provides the following
  - Original cylinder test date stamped on the cylinder
  - Recommended testing interval
  - Five open spaces for retesting dates

## Chapter 24 - Air Systems

- The manufacture’s test date (month &year) on each air tank shall be current within 12 months of the apparatus delivery date.
- Air tanks shall be marked with a label that reads “HIGH PRESSURE_____psi Breathing Air”

## Chapter 24 - Air Systems

- If air cylinders are to be refilled from a vehicle mounted system it shall meet the following requirements
  - **The system shall fully enclose the cylinder during filling to contain the fragments**
  - **The system shall fully enclose the refill lines to the cylinder**

**continued**

## Chapter 24 - Air Systems

- The system shall direct the concussive blast away from operators and by-standers. If the station is inside enclosed crew area shall have a vent to the exterior of the vehicle
- A means to prevent cylinders being filled unless the system is in the "cylinder fill operation position"
- A warning sign shall indicate the hazards inherent in the operation of filling cylinders

## Chapter 24 - Air Systems

Reels shall have a safety factor of 4:1

Reels shall have minimum capacity of 100ft of hose

Reel shall have a minimum of ½ " inside dia.

Reel shall be marked to indicate its intended use as follows

- Utility or Breathing air
- Operating pressure
- Total hose length
- Hose size (ID)

## Chapter 24 - Air Systems

The hose ends shall be color or marked with a label to designate operating pressure o the hose

Blue utility hose of 300psi

White breathing hose of 300psi

Yellow breathing hose of 301 up to 3000psi

Red breathing hose over 3000psi

## Chapter 24 - Air Systems

A low air warning system shall be provided that provides an audible warning when the air volume is at or below 20%

Air purification component shall be tested to ensure that the proper grade and that the following contaminants are within acceptable levels

- Carbon monoxide
- Carbon dioxide
- Oil vapors and Hydrocarbons
- Odor

## Chapter 25- Winches

- Chassis mounted
- 6,000 pound minimum
- 100 ft. cable (NEW 75' ft)
- Hydraulic or electric
- Control must be hand held with 25 ft. cord or approved radio control

## 26 Trailers *

- 26.2 Classification of Trailers.
- Trailers shall be classified as Type I, Type II, or Type III

## 26 Trailers *

- 26.2.1* Trailers that are designed to remain connected to their tow vehicle throughout the response event and that are dependent on the tow vehicle to provide the required electrical power and conspicuity shall meet the requirements of this chapter for Type I trailers.

## 26 Trailers *

- 26.2.2* Trailers that are designed to allow separation from their tow vehicle after arrival at the response event and that are not dependent on the tow vehicle to provide the required electrical power and conspicuity shall meet the requirements of this chapter for Type II trailers.

## 26 Trailers *

- 26.2.3* Open trailers designed to transport other vehicles, equipment, or containers that will be removed from the trailer after arrival at the response event and that will not be blocking the right-of way during the incident shall meet the requirements of this chapter for Type III trailers

## 26 Trailers *

Carrying Capacity.

- 26.3.1 The GVWR of the trailer shall not be greater than the sum of the tongue weight and the GAWR.
- 26.3.2 The stated load capacity of the trailer shall be the GVWR of the trailer less the empty weight of the trailer and the weight of the permanently mounted equipment

## 26 Trailers *

- Information Labels and Instruction Plates. (1) The length and width of the completed trailer in feet/inches (meters)
- (2) The stated load capacity
- (3) For Type I and Type II trailers, the height of the completed trailer in feet/inches (meters)
- (4) The hitch size and type

## 26 Trailers *

- (5) Maximum tire pressure
- (6) The tire manufacturer's maximum speed rating
- (7) The proper hitch-locking procedures to secure the trailer to the tow vehicle
- (8) A statement that reads: "It is the vehicle operator's responsibility to ensure that the towing vehicle and hitch are adequate to pull this trailer."

## 26 Trailers *

- 26.4.2 For trailers requiring the use of safety chains, an instruction plate shall be provided at or near the hitch location on the trailer that indicates the proper method of chain attachment to the tow vehicle.

## 26 Trailers *

- 26.4.3 For trailers with a braking system, an instruction plate shall indicate the proper method of connecting the braking system and the breakaway cable connections that apply the emergency brakes in the event the hitch fails.

## 26 Trailers *

- Fluids and Pressures Specific to the Trailer Chassis.
- A permanently mounted informational label shall be provided to specify the following information if it applies:
- (1) Brake fluid for trailer brake systems
- (2) Grease used for the lubrication of axle bearings
- (3) Any other special fluids, pressures, or lubricants required by the trailer manufacturer

## 26 Trailers *

- 26.7.2* Any trailer with an angle of departure of less than 8 degrees shall be equipped with means to prevent damage to the trailer if the rear contacts the ground.

## 26 Trailers *

- Wheel Chocks
- 26.9.2 Each wheel chock shall be designed to hold the trailer on a 10 percent grade when the trailer is loaded to its GVWR and parked independently of the tow vehicle

## 26 Trailers *

- The optical warning device
- 26.10.5.1 If the trailer is a Type I trailer, the optical warning system requirements of Section 13.8 shall be met by considering the combined tow vehicle and trailer as a single unit with its overall length

## 26 Trailers *

- 26.10.5.2 If the trailer is a Type II trailer, the optical warning system shall meet the requirements of Section 13.8 when the trailer is considered a single unit.

## 26 Trailers *

- 26.10.5.2.1 The trailer's Zone A lighting shall operate only when the trailer's onboard power source is operational and the tow vehicle is disconnected from the trailer.

## 26 Trailers *

- 26.10.5.3 If the trailer is a Type III trailer, the optical warning system shall meet the requirements of Section 13.8 for lower zones B, C, and D.
- Type I and II trailers shall be equipped with ground lighting that meets the requirements of 13.10.1.2.

## 26 Trailers *

- 26.11 Reflective Markings.
- 26.11.1 Type I & II trailers shall meet the requirements of 15.9.3 when the combined tow vehicle and trailer are considered a single unit with the overall length.

## 26 Trailers *

- Braking System.
- 26.6.1* All trailers chassis with a GVWR of 3000 lb (1360 kg) or greater shall be equipped with a braking system on each axle.

## Referenced Publications

- 74 Standards from 11 organizations
- Organization's address given
- Full name and date of issue of standard

## Appendix A - Explanatory Material

- Tied to specific paragraphs
- Explains intent
- Provides helpful suggestions

## Appendix B - Purchasing Specification Form

- Follows chapter layout and provides for recording local requirements specific to the apparatus being purchased.
- Purchaser should provide as part of specification.

IFSTA Pumping Apparatus
DRIVER / OPERATOR

Handbook
Service and Maintenance

## Daily Inspections

- The following can be found on page 40 of the IFSTA handbook
- Operate the pump and make sure the pump can be engaged.
- Make sure the auxiliary fuel tank is full in the case of separate engine driven pumps.
- Make sure all gauges and valves on pump panel are in working order.
- Check pump panel gauges against dashboard gauges.

## Daily Inspections

- Open and close valves to ensure proper operation .
- Be sure to close all drain valves.
- Drain all lines in areas were freezing may occur.
- Operate controls to check or inspect fire pump.
- Inspect water and foam tanks for proper fluid levels.
- Check all warning devices both visual and audible.

## Daily Inspections

- Check the underside of the apparatus and inside compartments for evidence of water or foam leaks.
- Check for damage, leaks, or obstructions in any auxiliary winterization system.
- Test roof and bumper turrets (if applicable) for proper operation.
- Check all components of the auxiliary fire suppression system on board.

## Weekly Inspections

- Flush the pump with clear water.
- Check and clean the intake strainers.
- Check the pump gear box for proper oil level.
- Check primer and primer oil level.
- Operate changeover valve while pumping water(multi-stage pumps).
- Check packing glands for excessive leaking, adjust per mfg. Instructions.

## Weekly Inspections

- Recalibrate flowmeters according to mfg. Instructions.
- Operate the pump pressure control device(s).
- Test foam proportioning system for accuracy.
- Refer to pump manufacturer's recommendations for additional instructions, if any.

## Monthly inspections

- Monthly inspection procedures are found in the IFSTA handbook page 25 to 39 and include the following.
- Proper tire inflation, valve stem condition, and tire condition.
- Pump intake caps hand tight , check pump discharges on front bumper if any
- Winches and hydraulic rescue tool systems check for damage and operation
- In-cab inspection includes all gauges and switches

## Monthly inspections

- Check steering system for excessive free play.
- Engine compartment including oil level, transmission fluid level, power steering fluid level and coolant levels.
- Check air filter restrictor gauge, emergency engine stop system and exhaust system.
- Windshield washer fluid levels.

## Monthly inspections

- Check brake fluid if applicable.
- Check belts and hoses.
- Check air system.
- Look for fluid leaking.
- Look over electrical wiring for loose connections or chaffing.
- Check windshield wiper blades for cracking.

## Periodic Inspections

- Lubrication: oil and filters should be changed at least every six months or at MFG. recommendation
- Air filters: change every six months or at MFG. recommendation

## Documentation

- Pump tests : annual pump test reports are kept and compared with previous reports to determine pump performance with normal wear and usage, and to determine the need for repairs prior to failure.
- Major vs. minor repairs: major repairs may require a pump test to insure that the pump will meet capacity.

## Documentation

- Preventive Maintenance records, Repair records, and Testing records: serve many functions. For use in warranty claims, in the event of an accident maintenance records are likely to be scrutinized by accident investigators. Proper documentation of recurrent repairs can assist in deciding whether to purchase new apparatus or continue to repair an older unit.

## Documentation

- Every fire department should have standard operating procedures (SOPs) for a systematic apparatus maintenance program.
- The SOPs should identify who performs certain maintenance functions, when they are to be preformed, how problems that are detected are corrected or reported, and how the process is documented.

## Documentation

- The SOP should clearly dictate those items that the driver/operators are responsible for checking and which conditions they are allowed to correct on their own.
- All driver/operators must be trained to use their department's record-keeping system.

## Principles of servicing and maintenance

- Voltage drop test
- Master battery disconnect
- Battery charging precautions(hydrogen gas)
- Testing open circuits
- Extended idle RPM (900 to 1100)
- Unnecessary short durations
- Oil change intervals

## Principles of servicing and maintenance

- Long idling periods
- Hydraulic filter change intervals
- Hyd. Cylinder leaks
- Pump packing leakage rate
- Intake relief valve
- Transfer case seals
- Pump packing adjustment
- Primer system, valves, line, and vent

## Principles of servicing and maintenance

- Valve linkage
- Valve seals
- Transmission interlocks
- Fluid color inspection
- Checking fluid leaks
- Air system pressure protection valve
- Using  a test light
- Using a voltmeter

## Principles of servicing and maintenance

- Driveline vibration
- Driveline seals

## NFPA 1911

Chapter 5 Retirement of Fire Apparatus

The fire department shall consider safety as the primary concern in the retirement of apparatus

Retired fire apparatus shall not be used for emergency operations.

## NFPA 1911

Chapter 6 general Requirements

It shall be the responsibility of the authority having jurisdiction to develop a written criteria for when the apparatus is taken out of service

## NFPA 1911

Chapter 6 general Requirements

Out of service apparatus shall be identified by one of the following means.

Sign on the outside of driver's door near the door handle

Special bag that covers the steering wheel

Large sign on drivers window

Highly visible mechanism at driver's position on the fire apparatus that all members of the department recognize as an out-of-service indicator

## NFPA 1911

Chapter 6 Driving and crew areas, Apparatus body and compartmentation

The following shall be considered when developing the out-of-service criteria

1) Body mounting that is defective
2) Cab mounting that is defective
3) Seat belts that are torn or have melted webbing, missing or broken buckles, or loose mountings. Due to the extreme safety related consequences of a defective seat belt, and the fact that one defective seat belt (unless it is the drivers belt does not render a piece of apparatus unusable, the AHJ shall take any seating position with a defective seat belt out of service

## NFPA 1911

4) Cracked or broken windshield that obstructs the driver's/operator's view
5) Missing or broken rearview mirrors that obstructs the driver's/operator's view
6) Windshield wipers that are missing or inoperable
7) Steering wheel that has a deficiency
8) Oil pressure gauge, or engine or transmission temperature gauges that have failed

## NFPA 1911

9) Air gauge or audio low air warning device that has failed
10) Door latches that are defective
11) Defrosters that are defective
12) Foot throttle that is defective

## NFPA 1911

6.3 Chassis, Axles, Steering & Suspension, Driveline, Wheels & tires The following shall be considered when developing the out-of-service criteria

1) Tires that have cuts in the sidewall that penetrate to the cord
2) Tires that are defective
3) Tires that have a tread depth of 4/32" or less on any steering axle or 2/32" or less on any non-steering axle at any two adjacent major tread grooves anywhere on the tire

## NFPA 1911

4) Suspension components that are defective
5) Wheel fasteners that are missing or broken
6) Wheels that are defective
7) Axle flanges that have Class 3 leakage
8) An axle that has any Class 3 leakage
9) Steering components that are defective
10) A steering component that has Class 3 leakage
11) Driveline components that are defective

## NFPA 1911

6.4 Engine systems

1) Air filter restriction indicator that shows maximum restriction
2) Engine that won't crank or start
3) Engine system that has Class 3 leakage of oil
4) Engine that is overheating
5) Oil that contains coolant
6) Oil that is diluted with fuel

## NFPA 1911

7) A fuel system component that has Class 2 leakage of fuel
8) Fuel tank mountings or straps that are defective
9) Stop-engine light that fails to turn off after engine is started

## NFPA 1911

6.5 Engine cooling system. The following shall be considered when developing the out-of-service criteria

1) Cooling system components that has Class 3 leakage
2) Coolant that contains oil
3) Radiator that is defective
4) Water pump bearing that is defective
5) Cooling fan that is defective
6) Coolant system components that are defective

## NFPA 1911

6.6 Transmission and clutch The following shall be considered when developing the out-of-service criteria

1) Clutch components that are defective
2) Transmission components that are defective
3) Shift linkages that are defective
4) Automatic transmission that overheats in any range
5) Automatic transmission that has a “Do not Shift” light on
6) Transmission components that have Class 3 leakage of transmission oil

## NFPA 1911

6.7 Low voltage & Line voltage electrical systems the following shall be considered when developing the out-of-service criteria

1) Federal department of transportation lighting that is defective
2) Ignition system that is defective
3) Charging system that is defective
4) Grounding & bonding of the line voltage electrical system that is defective

## NFPA 1911

6.8 Air brake systems The following shall be considered when developing the out-of-service criteria

1) Service brakes that have an air pressure drop of more that 2psi in 1 minute for single fire apparatus or more that 3psi in 1 minute for combination fire apparatus, with the engine stopped and service brakes released

## NFPA 1911

2) Leak down rate (time) of the applied side of the air brake that is more than 3psi in 1 minute for single fire apparatus or more that 4psi in 1 minute for combination fire apparatus, with the engine stopped and service brakes applied
3) Brakes that are out of adjustment
4) Braking system components that are defective
5) Braking operation that is ineffective
6) Parking brake operation that is ineffective

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7) Air compressor that fails to build air pressure

8) Air compressor that fails to maintain 80-90psi in the system with the service brakes applied and the engine at idle, or air compressor that fails to fill the air system to the air compressor governor cutout pressure with the service and parking brakes released

## NFPA 1911

9) Friction surfaces, brake shoes, or disc brake pads that have grease or oil on them

10) Brake lining or pads that are worn beyond the brake system manufactures minimum specifications

11) Rotors and drums that are worn beyond the brake system manufactures minimum specifications

6.8.1.2 Antilock braking system (ABS) warning indicator that is activated

## NFPA 1911

6.8.2 Hydraulic brake systems The following shall be considered when developing the out-of-service criteria

1) Brake system components that have Class 2 leakage of brake fluid

2) Friction surfaces, brake shoes, or disc brake pads that have grease or oil on them

3) Braking system components that are defective

4) Braking operation that is ineffective

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5) Parking brake operation that is ineffective
6) Brake warning light that is activated or brake pedal that falls away or drifts toward the flooring when brake pressure is applied
7) Brake lining or pads that are worn beyond the brake system manufactures minimum specifications
8) Rotors and drums that are worn beyond the brake system manufactures minimum specifications
9) Antilock braking system (ABS) warning indicator that is activated

## NFPA 1911

6.8.4 Wheel Chocks

If the apparatus is not equipped with two wheel chocks, mounted in a readily accessible locations, the condition shall be reported to the AHJ.

## NFPA 1911

6.9 Fire pump system The following shall be considered when developing the out-of-service criteria

1) Pump test results that fall below 90% of the original rating of the pump when tested in accordance with NFPA 1911
2) Pump that will not engage
3) Water tank that will not hold water
4) Pressure control system that is not operational

## NFPA 1911

5) Pump transmission components that have Class 3 leakage of fluid
6) Pump transmission lubricant that is contaminated
7) Pump panel throttle that is defective

## NFPA 1911

6.10 Aerial device systems The following shall be considered when developing the out-of-service criteria
1) Power takeoff (PTO) that will not engage
2) Stabilizer system that is defective
3) Aerial device that is defective
4) Hydraulic system components that are defective
5) Cable sheaves that are defective

## NFPA 1911

6) Cables that are defective or frayed
7) Base and section rails that show ironing beyond the manufacturer's recommendations
8) Aerial device that is structurally deformed
9) Torque box structure or fasteners that are defective
10) Turntable fasteners that are defective or missing

## NFPA 1911

2.2 Maintenance and repairs shall be made in accordance with manufactures recommendations. Parts or components used to maintain or repair the fire apparatus shall meet or exceed the original manufactures specifications

2.3.2 The authority having jurisdiction shall determine who is qualified to inspect and maintain fire apparatus and at what levels of maintenance each person is qualified to perform

## NFPA 1911

2.4.2 All federal state and local laws shall be followed in the use and disposal of chemicals and hazardous materials

2.5 Documentation

Records shall be maintained on all inspections, maintenance requests, preventive maintenance, repairs and testing results. Separate files shall be established and maintained for each individual fire apparatus